Essays in Efficiency and Stability of the Banking Sector

By

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AUTHOR'S DECLARATION

I wish to declare:

No part of this doctoral dissertation, titled as "Essays in Efficiency and Stability of the Banking Sector" and submitted to the University of London in pursuance of the degree of Doctor of Philosophy (Ph.D.) in Economics, has been presented to any University for any degree.

Parts of Chapter 4 were undertaken as joint work with Professor Silipo, Professor Kapetanios and Dr. Leonida.

Signed

Konstantinos N. Baltas

EXTENDED ABSTRACT

This thesis contributes via the concept of efficiency in four distinct fields of the financial economics and banking literature: technological heterogeneity, liquidity creation, profitability, and stability of banks.

In Chapter 1 we motivate the analysis by presenting the main developments that have been taking place in the banking sector as far as these four fields are concerned and highlight their importance to the appropriate functioning of the financial system and of the economy overall.

In Chapter 2 we address the issue that conventional surveys on bank efficiency draw conclusions based on the assumption that all banks in a sample use the same production technology. However, efficiency estimates can be severely distorted if the existence of unobserved differences in technological regimes is not taken into consideration. We estimate the unobserved heterogeneity in banking technologies using a latent class stochastic frontier model. In order to arrive at a policy implication that is valid across time and markets, we present two applications of the model using separately data from the UK and Greek banking sector over the periods 1987-2011 and 1993-2011 respectively. To increase the precision of our inferences, we adopt two distinct em-

pirical methodologies: a panel data method and a pooled cross-section modelling strategy. Our results reveal that bank-heterogeneity in both banking sectors can be controlled for two technological regimes. We find a trade-off between the level of sophistication within a financial system and its level of aggregate efficiency. Consistency among the results is established under both methodologies. Further, we propose a methodology with regard to M&As activity of UK and Greek banks within a latent class context. We examine numerous potential M&A scenarios among banks that belong to different technological regimes, and we test whether there is a transition of the new banks to a more efficient technological class resulting from this M&A activity. We find strong evidence that 'new' financial institutions can be better equipped to withstand potential adverse economic conditions. Finally, we cast doubt on what the true motivation for M&A activity is and we extract important policy inferences in terms of social welfare.

In Chapter 3 we introduce the "Cost Efficiency - Liquidity Creation Hypothesis" (CELCH) according to which a rise in a bank's cost efficiency level increases its level of liquidity creation. By employing a novel stress test scenario under a PVAR methodology, we test the CELCH and the direction of causality among liquidity creation and cost efficiency variables in the UK and Greek banking sector. Moreover using new measures of liquidity creation (Berger and Bouwman, 2009) we address the question of whether potential M&As can enhance liquidity creation and create additional credit channels in the economy. We evaluate and compare the robustness of potential consolidation scenarios by employing half - life measures (Chortareas and Kapetanios 2013). We show a positive impact of cost efficiency on liquidity creation in line with CELCH. The empirical evidence further suggests that potential consolidation activity can enhance the flow of credit in the economy. Bank shocks seem to be the most persistent on both liquidity creation and cost efficiency and the UK banking system is found to withstand more effectively adverse economic conditions. Finally, we cast doubts on the strategy followed by policy authorities regarding the recent wave of M&As in the Greek banking sector.

In Chapter 4, we attempt to shed light on the trade-off between financial stability and efficiency. We highlight that current tests of banking efficiency do not take into account whether banks' managers are taking too much or too little risk relative to the value maximising amount. We assume that moving from an intermediary bank type balance sheet to an investment bank type not only changes the risk-return combination of the balance sheet but also increases the banks' degree of instability, that is the probability of insolvency when adverse effects occur. To this extent, we propose a new efficiency measure which incorporates all the aforementioned ambiguous points. An empirical investigation of US commercial banks between 2003-2012 suggests that our proposed risk-adjusted index has superior explanatory power with respect to banks' profitability and gives better predictions compared to conventional banking efficiency measures. This holds after various robustness checks.

Chapter 5 summarizes the main findings of all three distinct studies and concludes by highlighting the importance and the contributing points of the thesis in the banking and financial economics literature.

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CONTENTS

List of Figures

List of Tables

Chapter 1

Introduction

This thesis investigates four distinct concepts in the financial economics literature with a special focus on the dominant segment of the financial system in all modern economies; i.e., the banking sector. Specifically we explore the technological heterogeneity, the liquidity creation, the profitability and the stability of banks. All these concepts are examined through a common lense: efficiency. Our motivation is driven by the fact that the appropriate functioning of various banking systems both in developed and emerging economies has been severely distorted by the global financial turmoil. Consequently, this has a severe impact on the world-wide financial stability due to the interconnectedness and the universal nature of banks which results in the distortion of the real economy by affecting severely households and firms due to the neuralgic position of the banking system in all modern economies.

The global financial turmoil was triggered by banks and as a result the banking sector was the first to confront the tremendous consequences of the crisis. The number of bank failures escalated to unparalleled levels. As a result the two central roles of banks raison d'etre in the economy; to transform risk and to supply liquidity, were severely vitiated. To better understand the major importance of the banking system in the stability of a country and how any decisions made by the policy authorities with respect to their viability can affect our every day lives, let's try to think of a different industry. For example, if an automobile or a shoe manufacturer is allowed to fail, then their competitors benefit. They take their place in the market, their customers, and possibly recruit some of their workers and replenish the vacuum. Thus, no risks arise for the wider economy and consequently there is no reason for the state to intervene. Conversely, if a bank is allowed to go bankrupt, competitors do not benefit, but on the contrary they are affected. Fear is created among depositors who rush to withdraw their money en masse from other banks and at the same time investors flee the country. The entire structure of the banking sector and the real economy therefore is threatened to collapse. The impact on the real economy, liquidity and market, is devastating. Thus, no economy is able to function without liquidity and banks.

The collapse of Lehman Brothers in September 2008 spread tremendous contagion effects in the financial systems throughout the world and made the need of action both on a bank-level and on a state level imperative. On one hand we experienced a big wave of bank consolidation activity and on the other hand we saw many banks being recapitalised by the state they belong to. In general, when the latter occurs it means that the ownership of these banks goes to the government; i.e., the taxpayer. Nevertheless, in some cases we saw that the state did not have the necessary funds to be able to proceed with the recapitalization process. This led some countries to seek the assistance of the International Monetary Fund. In addition, world-wide supranational institutions responded by committing to important unconventional measures and creating mechanisms in order to confront the severe adverse conditions that the crisis created.

As a result new regulations are established and others are still being debated to date. The most characteristic ones as far as the former is concerned are the forthcoming Basel III which introduces the Liquidity Coverage ratio and Net Stable Funding ratio and has as its main target to increase bank liquidity and decrease bank leverage; Vickers Proposals that suggests to separate retail banking from investment banking (Ring-fencing) as well as greater capital and loss-absorbing capacity; the Chartering procedure (screening of proposals to open new financial institutions) to prevent the adverse selection problem and the Examinations procedure (scheduled and unscheduled) to monitor capital requirements and restrictions on asset holding to prevent the moral hazard problem (C.A.M.E.L.S). As far as the latter is concerned, we experience extensive debates mainly in the European Union with regards to the establishment of a banking Union.

All these regulations and proposals have the three fundamental prerequisites that banks should be efficient, should be able to contribute to the stability of the financial sector and should contribute to the social well-being of the real economy. With this in mind this current thesis is devoted to the exploration of aspects that have a neuralgic role in these three prerequisites, such as the heterogeneity in the technology of banks; their ability to create liquidity; the level of their profit efficiency and how this affects the risk they carry and in extension their solvency and last but not least the trade-off between managerial gains and social economic prosperity with respect to their actions.

1.1 Outline of the thesis

In Chapter 2 we deal with the fact that surveys of bank efficiency intrinsically draw conclusions based on the assumption that all banks in a sample use the same production technology. Nevertheless, we highlight that failure in taking account of the existence of unobserved differences in technological regimes could lead to a severe bias in the estimation of efficiency by assigning incorrectly these deviations as inefficiency. We tackle this consideration by estimating the unobserved heterogeneity in the UK and the Greek banking technologies using a latent class stochastic frontier model. For the sake of persistence with respect to our extracted inferences, two distinct empirical methodologies are followed: a pooled cross-section method and a panel data modelling strategy. A novelty of our study consists of the fact that we examine numerous potential M&As scenarios among banks that belong to different technological regimes, in order to test whether there is a transition of the new bank to a more efficient technological class resulting from the M&A activity. We show that bank-heterogeneity can be fully captured by two different technological regimes. This holds under both modelling strategies. Our empirical evidence suggests that improved economic efficiency in both banking sectors can be the result of specific potential consolidation activity. This cast doubts on recent specific cases of Greek M&As that were not found to result in cost efficiency enhancement.

In Chapter 3 we stress the fact that the global financial crisis distorted one of the primordial functions of banks, i.e., their liquidity creation. With this in mind we suggest a novel hypothesis, the "Cost Efficiency-Liquidity Creation Hypothesis" that states that "cost efficiency" enhancement via banks' M&A can create internally both increased liquidity and social well-being surplus. In order to provide an empirical framework of our proposed hypothesis we suggest a novel use of a stress test scenario under a panel vector autoregressive (PVAR) methodology where we account for a macroeconomic, a financial and a bank shock. In this way, we are able to shed light on the direction of causality among cost efficiency and liquidity creation. Moreover, we investigate all historical and potential consolidation activity in the UK and the Greek banking sector with respect to their level of liquidity by using recent measures of liquidity creation (Berger and Bouwman, 2009). Finally, we provide an econometric framework to evaluate and compare the robustness of bank consolidation activity by employing new half-life measures (Chortareas and Kapetanios 2013). Via our proposed "Cost Efficiency-Liquidity Creation Hypothesis" we provide strong empirical evidence which reveals that specific potential consolidation activity can facilitate the flow of credit in the economy and at the same time contribute to the social welfare. This is established through the proposed stress scenario and precisely from the positive impact of cost efficiency on liquidity creation. Furthermore, we show that the direction of causality is stronger from liquidity creation to cost efficiency than the reverse direction. Comparison of the two banking sectors with respect to their liquidity creation indicates that the UK banking system is found to be more robust to all three different shocks. As far as the Greek banking sector is concerned, the half-life and total effect results of adverse macroeconomic and bank-specific conditions highlight that the Greek banking system was more robust with respect to liquidity creation before its recent systemic formation. This raises further scepticism over the decisions made by policy authorities and banks' managers as far as the recent wave of consolidation activity is concerned.

Chapter 4 addresses the issue that accustomed tests of banking efficiency do not take into account the fact the trade-off that might exist between banks' efficiency and stability. To be more precise we argue that conventional indicators of efficiency do not consider whether bank managers are taking too much or too little risk relative to the value maximising amount and consequently do not account on whether this alters the probability of insolvency when adverse effects occur. To be able to incorporate all these ambiguous points, we propose a new profit efficiency index which accounts for two different types of risks: credit risk and the risk deriving from excessive leverage. Thus, we are able to compare the deviation of banking efficiency estimates of our suggested risk-adjusted index and the conventional index in three different time horizons: 'pre-crisis'; 'during-crisis' and 'post-crisis'. Additionally we examine the explanatory and forecasting power of these two indicators accounting for an additional differentiation among banks; solvent and insolvent, both during the crisis and in the aftermath of the crisis. The empirical evidence highlights that our suggested index shows considerably less deviation of its estimated profit efficiency values among all different time horizons when we compare it to the standard profit efficiency indicator. Moreover, we show strong empirical evidence with respect to the superiority of the risk-adjusted index regarding both its explanatory and predictive power in contrast to the conventional profit efficiency measure. This holds in all periods that both indexes are examined and in all three divisions of the sample: all banks, solvent and insolvent. Our extracted inferences withstand various robustness tests. What is remarkable is that when both measures are considered in the same model the dynamic effects have as a result the conventional index to become ineffective and to create contradictory inferences with respect to fundamental assumptions that characterise the theory of profit efficiency.

Finally, chapter 5 draws the conclusion and summarizes the final remarks of the thesis.

Chapter 2

The joint investigation of heterogeneous production technologies and efficient M&A in the banking sector: Implications for social welfare in the era of the financial crisis.

2.1 Introduction

Efficiency of the banking system is one of the major issues preoccupying the new monetary and financial establishment as it is at the heart of a country's financial system. It is generally accepted that efficient bank operation, which is linked to financial stability, allows entrepreneurs and households to enjoy higher-quality services at lower costs. Thus, measuring the efficiency of a banking system and analysing the factors that explain it is very important for the supervisory authorities in order for them to design the regulatory framework and for bank managements to draw their business plans. It is indeed necessary to identify the nature of inefficiencies. These can occur due to information on the most effective processes not being easily accessible, free, or perfect. These have a direct impact on the time needed for each credit institution to respond to changes in environmental or market conditions. Therefore, the contribution that inefficiencies have on organizational learning, is not neglegible and constitutes unavoidably an important source of differences among financial instututions since they can create a competitive advantage in the long-run.

Nevertheless, surveys on bank efficiency implicitly draw conclusions based on the assumption that all banks in a sample use the same production technology. Neglecting the existence of unobserved differences in technological regimes can have distorting effects on efficiency estimates by assigning incorrectly these deviations to inefficiency (Koetter, Poghosyan 2009). Indeed, financial institutions in a country's banking sector may use different technologies. It is important to address this issue given the key role that banks have as financial intermediaries in the process of transformation from a planned to a market economy regardless of the country's level of sophistication of its banking system. The aim of the current study is to identify different technological regimes within a country's banking system and more importantly to reveal the classification of each financial institution to these potential regimes. In order to amplify the validity of our inferences, we examine two very different banking systems in terms of their level of sophistication.

Firstly, we focus our attention on the UK banking system. It can be characterized as a complex sector with advanced capital market. Its financial institutions have expanded their roles beyond their traditional payment services, intermediation between savers and borrowers, and insurance against risk function by adopting a more universal type of banking. The members of the UK banking system are of major importance for public authorities, since they were among the first credit institutions to suffer the impact of the recent global financial meltdown. The consequences of the crisis were severe not only for UK's public finances and capital market, but also for the financial segments and public sectors of the geographical areas that UK financial institutions are interconnected with. This becomes clear, if one looks at the level of intervention made by the UK government which results in a total of £550 billion, following two bank rescue packages in 2008 and 2009 via the 'Special Liquidity Scheme' and the 'Bank Recapitalisation Fund'. Additionally, monetary authorities unavoidably had to take action and intervened by lowering interest rates to 0.5%, a figure which " - at the time of writing - " remains unchanged. The Monetary Policy Committee (MPC) recognizes that the bank rate can not be reduced any further and in order to give a further monetary stimulus to the economy, it has undertaken unconventional monetary action. Specifically, the Bank of England (BoE) has committed a total amount of £375 billion to its asset purchasing program (Quantitative Easing) to date.

The second country of interest is Greece, where the stability of its simpler banking sector and its role as a financial intermediary have been distorted by the financial turmoil. Before the onset of the crisis, Greek banks were unequivocally seen as well managed and prudent, which can be justified by the fact they didn't experience severe consequences from the first wave of the crisis , the 'Financial Crisis' which occurred after the collapse of Lehman Brothers in August 2007. Nevertheless, the picture changed when the second wave of the global economic crisis, the 'Sovereign Debt Crisis, became apparent. As in the case of the UK, fiscal authorities intervened and tried to recapitalize Greek banks. However, that was not enough for the Greek banks to withstand the augmented and more frequent cracks from the debt crisis, since they constituted the main holders of the so called 'toxic' government bonds whose value decreases every day. In turn, the more the increase in the country's public debt, the more fragile the nation's banks become. Two rescue bail-out packages were issued which totalled 240 billion euros. These are part of the two respective memorandums agreed between the Greek government and the so-called Troika (European Commission, European Central bank, International Monetary Fund). Consequently, Greek financial intermediaries are found to be trapped in the middle of their country's turmoil, severed from international lines of credit and able to borrow only from the European Central Bank and the International Monetary Fund.

The fundamental differences in the structure and the impact that the global financial turmoil had on the two disparate banking systems, triggered our motivation to conduct an empirical analysis in order to investigate the existence of any unobserved classification of both countries' financial intermediaries into distinct technological regimes (i.e. business models) and identify their main characteristics. Therefore, we are able to deduce some common policy implications for both UK and Greece in line with recent debates regarding the creation of a unique

European banking regulatory framework, the so-called 'CRD IV' package of the European Banking Authority (EBA).

2.1.1 Developments

At this point, it is interesting to review how these two dissimilar banking systems evolved.

The post-war period at the 1950's was when the UK monetary system entered a brand new era of development and innovation. The banking sector experienced a considerable increase in provincial branch offices and introduced the concept of high street banking. At the end of 1950's, 100 banks provided information to the monetary authorities, the so-called 'Radcliffe Committee', and 16% of them, consisting mainly of Scottish and London clearing banks accounted for 85% of the whole sector's assets and more than 30% of UK GDP (Capie 2012). Clearing banks and building societies were the two most important lenders of the UK economy, with mediocre activities, such as provision of payment services, deposit-taking activities and short-term corporate lending. By the end of the 1970's, the two aforementioned categories of credit institutions experienced a considerable expansion on the asset side of their balance sheet. A milestone in the evolution of the UK banking sector during those two decades was the establishment of foreign-owned banking institutions which were mainly involved in wholesale activity, reflecting in a way the rise of the Eurocurrency market[1]. Another important characteristic of the UK banking sector is the demutualization

[1] The Eurocurrency market is a money market that provides banking services to a variety of customers by using foreign currencies located outside of the domestic marketplace. The concept is not connected with the European Union or the banks associated with the member countries, although the origins of the concept are heavily derived from the region. Instead, it represents any deposit of foreign currencies into a domestic bank.

wave of the mid 1990's. The number of building societies fell sharply since many of them demutualized and became banks. Albeit the number of banks almost tripled over the last 30 years, the provision of retail services was highly concentrated due to a consolidation process which constituted the concept of the 'big-four'[2]. The latter part of the 20th century freed competitive forces in the banking system mainly via 1979's Banking Act[3] and allowed banks to pursue efficiencies through functional and geographical expansion due to the implementation of the first Basel accord in 1988. The concept of 'Universal banking' was born. To be more precise, after the consolidation and demutualization process, the largest financial institutions in the UK expanded the variety of services and products they provided. Thus, apart from the traditional retail type of activities such as deposit taking and lending, which were captured by the 'commercial' division of a Universal bank, two new divisions were developed as well, the 'investment' and the 'insurance' division. The former deals with the securitization, and includes issuing, underwriting and distributing securities, whereas the latter offers products for individuals to transfer risk from one party to another for a premium. Initially the concept of 'Universal banking' was considered to mitigate risk, since it allows the commercial division of the bank to diversify into other activity areas and thus reduces the risk of failure. Nevertheless, the recent financial turmoil revealed that some nonbank activities may be more risky than banking activities since they are able to create financial distress via the extensive

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[2] The term 'big-four' refers to the largest four UK banking groups: Barclays, HSBC, Lloyds, RBS.

[3] This Act, established the notion of banking supervision and created a two-tier system of banks and licensed deposit-takers. Albeit, in the beginning barriers to entry were created by this distinction, in the end UK banking competition was increased from both foreign banks and non-bank institutions (see Mathews et al. 2007).

network interconnectivity of large universal financial institutions. As a result the 'Independent Commission on Banking' was established in 2010 having as it's primordial role the consideration of structural and related non-structural reforms in the UK banking sector in order to promote financial stability and competition.

Turning to the Greek banking sector, it has undergone major restructuring in recent years which has been highlighted by both academics and practitioners[4]. Until the 1980's, the two key characteristics of the Greek banking sector were substantial constraints and administrative regulations which reflected a high degree of government intervention. The establishment of the Basel I accord in 1988, the implementation of common European legislation among the country-members, the developments in the financial industry and the need for enhancement of competitive forces globally among banks constitute the main reasons that triggered the acceleration of liberalization and deregulation of the Greek financial system. The latter trend was initiated by the adoption of the Second Banking Directive, the establishment of the single EU market in view of the country joining the European Monetary Union (EMU), the determination of interest rate liberalization, the release of capital movements and the internationalization of competition. The Greek banking sector also experienced considerable improvements in terms of communication and computing technology, as banks expanded and modernized their distribution networks, which apart from the traditional branches and ATMs, now include alternative distribution channels such as internet banking. As the Annual Report of the Bank of Greece (2011) highlights, Greek banks have taken major steps in recent years towards the annulment of various credit rules, by

[4] Pasiouras (2012), provides an excellent survey of the development of the Greek banking sector.

introducing credit scoring and probability default models. To compete in the new financial landscape, Greek financial intermediaries expanded and upgraded their distribution networks, they ameliorated their information technology, and they invested in advanced monitoring and risk management systems. Now, Greek commercial banks are transforming themselves into financial groups, increasing their off-balance sheet operations and non-interest income as they move towards the model of universal banking and adding subsidiaries such as insurance companies, brokerages, credit card companies, mutual fund firms, so as to offer additional services. It is worth noting that the whole banking industry was restructured by two waves of consolidation, one in the end of the 1990's and one in the beginning of 2010's. The consolidation occured mainly in order to amplify the dominance of individual banking groups domestically and to create an adequate size for them to compete in the EU single market. Apart from Cyprus and USA, the large Greek banks expanded their activities abroad on the wider market of the South Eastern European region. (e.g. Albania, Bulgaria, FYROM, Romania, Serbia). This trend signifies that at least before the country's sovereign-debt crisis occured, Greek banks in the region had some comparative advantage, of access to capital markets, and of good understanding of local conditions. Going forward, the performance of the subsidiaries operating abroad is expected to have an impact on the performance of parent banks and consequently on future decisions for further internationalization attempts. On the other hand, the second wave of mergers and acquisitions was triggered by the Greek sovereign debt crisis. Specifically, Greek banks were cut off from international markets, faced a large outflow of deposits and incurred significant losses from the haircut on public debt in the context of Private Sector Involvement (PSI). These adverse developments signaled that the Greek banking system could not continue with its previous structure in the new era. For this purpose, the Hellenic Financial Stability Fund (HFSF) was established and in accordance with the European Financial Stability Fund (EFSF) set the foundations for a series of resolutions of certain banking institutions and their acquisitions hereafter within 2012 and 2013. As a result of the aforementioned consolidation activity, four systemic banks were created, the so-called four cornerstones of the Greek Economic recovery. Lastly, the HFSF initiated the recapitalisation process of the new banking system, in order to boost the confidence of domestic savers and international financial markets in Greek banks. Consequently, as it is quoted in the interim report of the governor of Greece's central bank (Bank of Greece, 2012), both the restructuring and recapitalization processes will help relieve the liquidity constraints faced by banks, by favourably affecting the inflow of deposits and banks' ability to regain access to international money and capital markets.

2.1.2 Literature Review

Definition of Efficiency

Efficiency from a broad perspective can be viewed as a measure of the deviation between actual performance and desired performance. Thus, efficiency must be measured relative to an objective, it can be measured with respect to maximization of output, maximization of profits, or minimization of costs. Duality theory can be used to derive the cost function from the production function, and cost is a component of profit; hence, the three concepts are not independent. Scale economies, scope economies, and X-efficiency are different aspects of performance.

Scale and scope economies refer to selecting the appropriate outputs, while X-efficiency refers to selecting the appropriate inputs. Typically, scale economies refer to how the firm's (i.e. a bank) scale of operations (its size) is related to cost i.e., what percentage increase in costs occurs with a 1-percent increase in scale. A firm is operating at constant returns to scale if, for a given mix of products, a proportionate increase in all its outputs would increase its costs by the same proportion; a firm is operating with scale economies if a proportionate increase in scale leads to a less than proportionate increase in cost; a firm is operating with scale diseconomies if a proportionate increase in scale leads to a more than proportionate increase in cost. Scope economies refer to how the firm's choice of multiple product lines is related to cost. A firm producing multiple products enjoys scope economies if it is less costly to produce those products together than it would be to separate production into specialized firms. X-efficiency measures how productive the firm is in its use of inputs to create output. If all firms in an industry are producing the scale and combination of outputs that minimize the average cost of production, then the total cost of producing the industry's output is minimized, and the industry is producing the efficient combination and level of products, provided each firm is using its inputs efficiently. Firms that exhibit X-inefficiency are either wasting some of their inputs (technical inefficiency), or are using the wrong combination of inputs to produce outputs (allocative inefficiency), or both.

A fundamental decision in measuring financial institution efficiency is which concept to use, and the choice will depend on the question being asked. The concept chosen should be related to economic optimization in reaction to market prices and competition, rather than being based solely on the use of technology. We can ask the question, is the firm maximizing the amount of output it produces given its inputs or minimizing the amount of inputs it uses to produce a given level of output i.e., is it operating on its production frontier but that is a question about technological optimization. This is less interesting from an economic perspective, since it ignores values. Instead, we would like to investigate questions of economic optimization. For example, is the firm minimizing its costs of production given its choice of inputs, taking input prices as given; is the firm maximizing its profits given its choice of inputs and outputs, taking input and output prices as given. The strand of the literature that has received a considerable attention by researchers focuses on simple objective functions, like output maximization, cost minimization, or profit maximization, but other studies acknowledge the fact that the objectives of firm management may differ from these and try to incorporate this into efficiency measurement, or focus on more market-based definitions of efficiency, e.g., operation on a risk-return frontier

Efficiency in the UK banking sector

Surprisingly, there are considerably fewer studies that investigate the efficiency of the UK banking system compared to other European and overseas countries[5]. The first study we examine is by Hardwick (1989). He investigates the scale economies of UK building societies by estimating a translog total cost function jointly with the derived input cost share equations. He defines total cost to include the interest cost of borrowed funds as well as the operating costs of employing labour and capital services. In addition to the usual elasticity, he develops three fur-

[5] We exclude cross-country studies and we focus only on surveys where UK and Greece individually are the countries of attention.

ther scale economy measures: 'input-specific economies of scale', 'augmented economies of scale' and 'augmented input-specific economies of scale'. The results tend to indicate that only modest economies of scale are present and that they are exhausted at relatively low asset levels. Hardwick (1990) examines the behaviour of building societies' operating costs on the assumption that societies produce just two outputs: one output supplied to mortgage borrowers and the other supplied to depositors and shareholders. The results indicate that there are statistically significant economies of scale for societies with assets of up to £5,500 million so long as the two outputs are expanded proportionally. He concludes that there exists a clear cost incentive for further growth among all but the largest building societies: this may have contributed to the 'urge to merge' which has become such an important feature of the building society industry. Field (1990) uses a cross-section sample of building societies in 1981, to measure their relative efficiency and to examine whether the efficiency factor is the driving force behind the merging of small building societies. His results indicate a wide disparity in efficiency and he concludes that these differences are not related to the size of building societies, but rather to managers' skill and motivation. Drake and Howcrof (1994) investigate the relative efficiency of a UK clearing bank's branches using a non-parametric programming methodology. This technique is utilized to investigate the causes of observed inefficiency in the case of one illustrative branch example in detail. Optimal bank branches where deemed to be those which had total lending of between £3 - 5.25m and an average of nine employees. Altunbas et al. (1995) examine the efficiency and mergers in the UK (retail) banking market. Their results indicate a high level of efficiency of around 0.90 for the British banks. Drake et al. (1996) use both a non-parametric and parametric frontier approach to calculate the efficiency of U.K. building societies and to compare the empirical findings among the two different modelling strategies. The results on overall efficiency are contrasted between the approaches. Hardwick (1997) investigates the cost inefficiency of UK life insurance companies to identify likely gainers and losers and to examine the effects of increasing competition on the structure of the UK life insurance industry. He estimates a flexible stochastic cost frontier using a sample of 54 companies over five years. The estimated frontier is then used to compute measures of 'economic', 'scale' and 'total' inefficiency for different company size groups. His results show that, on average, larger life insurance companies are less inefficient than smaller companies, but there are substantial variations in the degree of inefficiency within size groups. Ashton in a working paper (1998) empirically quantifies firm specific 'distribution free' cost efficiency, economies of scale and economies of scope in the UK building society sector between 1990-1995. He employs both a flexible Fourier and a translog functional form with an intermediation representation of depository institution production. Differences in the performance of these two functional forms are found. A broad distribution of cost efficiency over the sample period is observed, with a mean efficiency of 76 % estimated using the flexible Fourier form and a mean efficiency of 72.52 % estimated employing the translog form. Distinct results for economies of scale are produced with the two models. Ashton (1998) investigates efficiency characteristics of the British retail banking using a fixed effects model with a translog specification of productive technology, accounting for both 'production' and 'intermediation' models of bank production. He reports a substantial distribution of cost efficiency in the commercial sector and slight dis-economies of scale are reported for the 'intermediation' approach. Substantial diseconomies of scale are also recorded for the 'production' approach. In the end he argues that a substantial dispersion of cost efficiency is observed for this sector with both model specifications. The same author in (2001) measures distribution-free cost efficiency, economies of scale, economies of scope and cost complementarities of the British retail-banking sector by employing a one way fixed effects model with a translog specification of productive technology. The results derived by both 'production' and 'intermediation' models of bank production indicate an increasing and a low level of dispersion of cost efficiency among these spesifications. Drake (2001) investigates relative efficiencies and productivity change in the UK banking Industry using a data sample covering the main UK banks over the period 1984-1995. He uses the Data Envelopment Analysis (DEA) and finds important insights into the size-efficiency relationship in UK banking. Drake and Simper (2002), analyse the scale efficiency of UK building societies by an advanced entry/exit model. They find that there is considerable divergence across building societies in levels of scale efficiency and in technological change during the sample period 1992–1997. Further the paper finds that scale economies and technological change estimates are dependent on whether the econometrician balances a panel data set or utilises the entry/exit model specification. They conclude that scale economies in UK building societies are found to be more significant and more pervasive than in previous studies. Drake and Simper 2003 analyse the changing efficiency, technological change and competitive market structure of the major retail stock (plc) banks and mutual building societies in the UK. The results indicate that the relative performance of the three sets of institutions (banks, building societies and converters) varies considerably over the sample period, and that the plc. conversion process appears to confer only a temporary benefit (in terms of relative performance) on converting mutual building societies.

Additionally, they provide empirical evidence that the major retail financial institutions in the UK can be characterized as operating within a monopolistically competitive market structure.

Webb (2003) investigates the relative efficiency levels of large UK retail banks during the period of transition 1982–1995 by using DEA window analysis. He finds that for the entire sample the mean inefficiency levels are low in comparison to past studies and that the overall long run average efficiency trend is falling. Moreover he notes, that scale inefficiencies dominate pure technical inefficiencies, smaller banks are more likely to report technical inefficiency and that during the 1990s banks with asset levels over £105bn suffered decreasing returns to scale. Kosmidou et al. (2006) employ the PAIRCLAS multicriteria methodology to investigate the performance of UK small and large banks over multiple criteria, such as asset quality, capital adequacy, liquidity and efficiency/profitability. Their results indicate that small banks exhibit higher overall performance compared to large ones and that the ratios used in the study contribute significantly to the discrimination between large and small banks. Matthews et al. (2007) report an empirical assessment of competitive conditions among the major British banks, during a period of major structural change. By measuring competition by the Rosse–Panzar H-statistic for a panel of 12 banks for the period 1980–2004, they find that competition in British banking is most accurately characterised by the theoretical model of monopolistic competition. Additionally, they note competition appears to have become less intense in the non-core (off-balance sheet) business of British banks. Ashton et al. (2007) provide an empirical assessment of the efficiency and interest rate changes occurring during 61 UK retail bank mergers. They mention as key findings the general efficiency enhancing influence of UK bank mergers and the limited effect of mergers on retail interest rates. Tanna et al. (2011) use data envelopment analysis to estimate several measures of the efficiency of banks, and then use panel data regressions to investigate the impact of board structure on efficiency. They provide evidence of a positive association between board size and efficiency, although this is not robust across all their specifications. Board composition, by contrast, has a robustly significant and positive impact on all measures of efficiency. Finally , Xiang et al. (2011), employ a mixed two-stage approach to estimate and explain differences in the cross-country efficiency of ten Australian, five UK and eight Canadian banks over the period 1988 to 2008 using stochastic distance, cost and profit frontiers. Their empirical evidence indicates that Australian banks exhibit superior efficiency compared with their Canadian and UK counterparts. Additionally they mention that key factors that affect efficiency positively consist of the level of intangible assets and the loans-to-deposits and loans-to-assets ratios. On the contrary, bank size, the ratios of loan loss provisions-to-total loans and the debt-to-equity ratio constitute the factors that are negatively correlated with efficiency.

Efficiency in the Greek banking sector

Turning to studies that examine the efficiency of the Greek banking system, we provide an overview of the scope and the main inferences of a representative sample of them. An econometric approach for the first time was employed by Karafolas and Mantakas (1996). The authors use a second-order translog cost function to estimate the costs in the Greek banking sector and investigate economies of scale. Using data for eleven commercial banks from the period 1980 to 1989, they find that although operating-cost scale economies do exist, total cost scale economies are not present. Finally, their findings indicate that on average, Greek banks should increase their size to be able to exploit fully the benefits of economies of scale. Noulas (1997) examines the productivity growth of ten private and ten state banks operating in Greece during 1991 and 1992. He follows the intermediation approach and DEA method to measure efficiency. The results derived from the estimation of the Malmquist productivity index indicate that the Greek banking sector seems to have experienced an increase of productivity by about 8 per cent, with state banks obtaining higher productivity growth than private banks. The results also indicate that the sources of this growth differ across the two types of banks. State banks' productivity growth is a result of technological progress, while private banks' growth is a result of increased efficiency. Christopoulos and Tsionas (2001) estimate the efficiency in the Greek commercial banking sector over the period 1993–1998 using homoscedastic and heteroscedastic parametric stochastic frontiers. The authors find an average technical inefficiency about 20 per cent for the heteroscedastic model and 17 per cent for the homoscedastic one. They report that technical and allocative inefficiency decreases over time for both large and small banks implying that there is room for amelioration. Spathis et al. (2002) use a multicriteria methodology to investigate both the differences in profitability and efficiency between small and large Greek banks and the factors of profitability and operation related to the size of banks. Their empirical evidence indicates that large banks are more efficient than small ones. Christopoulos, et al. (2002) examine the same sample with a multi-input, multi-output flexible cost function to represent the technology of the sector and a heteroscedastic frontier approach to measure technical efficiency. They find that small and medium-sized banks are almost fully efficient, while in large banks efficiency measures range from 60 per cent to 95 per cent. They also report that investments, bank loans and economic performance are positively related to cost efficiency. In a later study, Tsionas et al. (2003) use the same sample as in Christopoulos and Tsionas (2001) and in Christopoulos et al. (2002) but employ DEA to measure technical and allocative efficiency, and the Malmquist total factor productivity approach to measure productivity change. The results indicate that most of the banks operate close to the best market practices with overall efficiency around 98 per cent and that larger banks seem to be more efficient relative to smaller institutions. The Malmquist index indicates that an increase by 3.8 per cent in total factor productivity occurred over the period and technical inefficiency seems to play a less important role than allocative efficiency. Halkos and Salamouris (2004) also use DEA but in contrast to previous studies, the authors include a number of financial efficiency ratios as output measures in the DEA model to calculate the efficiency for a sample of Greek commercial banks. The results indicate a wide variation in average efficiency over the period 1997–1999, and a positive relationship between size and efficiency. They also report an increase in banks' profitability which is mainly due to their accession in the Athens Stock Exchange Market instead of conventional banking activities.

Apergis and Rezitis (2004) specify a translog cost function to analyse the cost structure of the Greek banking sector, the rate of technical change and the rate of growth in total factor productivity. Their dataset consists of four state and two private Greek banks for the period 1982–97. Overall, their findings show significant economies of scale, implying that Greek banks could improve their cost efficiency levels by engaging in activities such as mergers and acquisitions. They use both the intermediation and the production approach and both models indicate significant economies of scale and negative annual rates of growth in technical change and in total factor productivity. Athanasoglou and Brissimis (2004) study the impact of recent mergers and acquisitions (M&As) on the cost and profit efficiency of banks in Greece. They apply three methods: (i) analysis of developments in certain cost and profit indicators and their dispersion for bank groups according to their size; (ii) calculation of cost and profit inefficiency (relative to the best performer); and (iii) analysis of individual cases of M&As in terms of changes in bank costs and profitability relative to banks not involved in M&As. Additionally, the paper assesses the existence of economies of scale and the extent to which they are exploited through M&As. Their empirical results indicate that M&As, in particular those involving small banks, had a positive effect on cost and profit efficiency and that scope exists for further improvement in efficiency. Also, M&As helped large banks to exploit economies of scale, which previously were found in small to medium- sized banks. Rezitis (2006) measures efficiency and productivity for the Greek banking sector over a relatively long time period: 1982–97. He uses the same dataset but employs the Malmquist productivity index and DEA to measure and decompose productivity growth and technical efficiency, respectively. He also compares two sub-periods 1982–92 and 1993–97 in order to test the effects, if any, of intense deregulation and liberalization after 1992, and employs Tobit regression to explain the differences in efficiency among banks. The results indicate that the average level of overall technical efficiency is 91.3 per cent, while productivity growth increased on average by 2.4 per cent over the entire period. The productivity growth is attributed mainly to intense competition and to the internationalization process that characterized the Greek banking sector over the second half of the 1990s. The same author (Rezitis 2008) investigates the effect of acquisition activity on the efficiency and total factor productivity of Greek banks. The empirical evidence indicates that the effects of mergers and acquisition on technical efficiency and total factor productivity growth of Greek banks are rather negative. Pasiouras (2008) uses the DEA method to examine technical efficiency and scale efficiency in the period 2000-2004. Besides traditional variables used in similar studies, he also analyses the effects on efficiency of banks' exposure to credit risk and to off-balance sheet items risk. According to his findings, taking account of credit risk increases Greek banks' efficiency, while banks with activities abroad record higher efficiency. Moreover, technical efficiency appears to be more important than scale efficiency, although only slightly more so. Finally, Greek banks' efficiency seems to depend positively on each bank's capitalization, the level of loans and market share. Pasiouras et al. (2008) examine the association between the efficiency of Greek banks and their share price performance. Their empirical evidence indicates a positive and statistically significant relationship between annual changes in technical efficiency and stock return. Floros and Giordani (2008b) investigate the contribution of the number of ATMs by modelling and estimating banking efficiency. They show that large banks are more efficient than medium and small sized banks and banks with a large number of ATMs are more efficient than those with a fewer number of ATMs. They note as well that the provision of e-banking services by banks does not influence their efficiency scores.

Asimakopoulos et al. (2008) use the DEA method by employing profit and loss data in a sample of Greek banks in the years 1994 to 2006. Their results show an improvement over time, attributable mainly to the rise in allocative efficiency. Larger and smaller banks appear to be more efficient than medium sized banks, and, on average, banks targeted for acquisition exhibit lower efficiency than the rest. Moreover, a positive relation with efficiency is found for determinants such as the banks' capital adequacy, profitability, and loan portfolio quality. Giokas (2008a) explores the efficiency of bank branches and finds that there is a scope for substantial efficiency improvements (average inefficiency of 12%) which can generate a substantial increase in profit for the bank. In Giokas (2008b) his results show an average efficiency of 75 % and that rural branches tend on average to be more efficient than urban branches. Gaganis et al. (2009) use data envelopment analysis to explore the efficiency and productivity of the 458 branches of a Greek commercial bank. The authors then use fixed and random effects models to determine the impact of internal and external factors on the efficiency and productivity scores. The results indicate that the branches in the sample could have achieved improved overall performance during 2002-2005. Gaganis and Pasiouras (2009) estimate an input oriented DEA model under variable returns to scale, with inputs and outputs selected on the basis of a profit-oriented approach for the period 1999-2004. They find that the average pure technical efficiency during 1999–2004 was 0.7325 indicating that banks in Greece could improve their efficiency by 26.75%. Over the same period, scale efficiency was between 0.58 and 0.87 with an average equal to 0.68. Chortareas et al. 2009 provide a characterization of the Greek banking system's efficiency and productivity under the new environment that the Economic and Monetary Union (EMU) participation implies. They consider cost and profit efficiency as well as productivity change of commercial banks using the nonparametric Data Envelopment Analysis (DEA) and the Total Factor Productivity (TFP) Malmquist Index in the period 1998-2003. Their findings suggest that cost efficiency has risen by 4.3% over the 6 years under study. Moreover, they note that Greek banks seem to enjoy relatively high profit efficiency (on average 75%) showing an increase by 93% over 1998-2003. Similarly, productivity seems to have risen by 15% and this is mainly driven by the improvements in the performance of best-practice institutions. Finally, their results do not show any role for OBS activities in Greek banks' efficiency. Chatzoglou et al. (2010) in a sample of Greek banks from 2004 to 2006 use DEA by constructing output measures by standard ratio measures of bank financial performance in combination with efficiency analysis. Their findings indicated that Greek banking efficiency remains relatively stable and on average big banks perform better than medium and small banks. Siriopoulos and Tziogkidis (2010), examine the reaction of banking institutions after significant events such as M&As, privatizations and the crisis of the Athens Stock Exchange in 1999. Their results from a DEA modelling strategy suggest that the Greek banking sector operates efficiently on average during the destabilization periods. In the following year, Pasiouras et al. (2011), assess the cost efficiency of the Greek cooperative banks over the period 2000–2005, where first they use a DEA approach and in a second stage, they use a bootstrapping censored (Tobit) regression. The DEA results suggest that there is room for Cooperative banks to improve their cost efficiency, specifically the allocative one. Additionally, albeit not robust across other efficiency measures, they find that bank total assets and the equity to assets ratio, as well as the GDP per capita and the unemployment rate in the region are the main factors that influence efficiency. Liargovas and Repousis (2011) examine the impact of mergers and acquisitions on the performance of Greek banking sector over the period 1996-2009, by using two approaches; event study methodology and operating performance. The results from the event study methodology, using a 30-day event window indicate that stock prices show significant positive cumulative average abnormal returns (CAARs) before the announcement for a period of ten days (for targets and bidders banks). As far as the operating performance is concerned, the results indicate that it does not improve following mergers and acquisitions while there are controversial results when comparing merged banks with the group of non-merging banks.

Our study differs from the above which focus on the UK and Greek financial sector in that it adds insights in several respects, as discussed below. A main novelty of this study is that, it is the first empirical application that attempts to examine the strand of technological heterogeneity in two completely different in terms of "sophistication, market characteristics and volume of transactions" banking systems, the UK and the Greek one". An additional contribution is the strategy we follow in our examination. In this respect we estimate, separately for each country, a stochastic production frontier using a latent class modelling approach. To the best of our knowledge this is the first study in both banking systems to apply a latent class stochastic frontier model. Furthermore, this is the first time in the literature of latent class stochastic frontier studies that two countries are being investigated separately and not jointly. This is of major importance and in what follows we explain the intuition behind it. The primordial reason which motivates our approach is the fact that disdaining the tremendous differences in regulation, in supervision, in size and generally in market conditions and including both countries in the same sample assuming that they are homogeneous, would create a large scale bias in our estimates and consequently no robust inferences could be extracted. The reasoning behind this lies in two arguments. The first one lies to the theory of the stochastic frontier, which assumes that the best-practice bank lies on the frontier and consequently constitutes the benchmark against which the performance of any other financial institution in the sample is compared. Nonetheless, each bank's strategic decisions within each country are influenced by local characteristics and environment (i.e. competition, market concentration, regulatory framework). Thus, it becomes inappropriate to group together banks from different countries. The second reasoning which leads to the differentiation of our paper from the bulk of all previous studies in the literature of heterogeneity and latent class modelling (see Barros et. al 2007) , is based on the fundamental misconception, that extracting inferences and attempting to implement a common policy based on a sample of banks coming not only from different countries but from different in nature activities can be inappropriately labelled as homogeneous common frontier. Thus, we argue, that any attempt to formulate a common policy implication in the area of heterogeneity, by definition requires an empirical modelling based on different bank-types and on different countries. Only in this way a researcher can be sure that he/she measures accurately the impact of different in nature banks in each of the different country they belong to (see Berger 2007). In turn, at first we identify the impacts that each different technological regime of banks has on the country that it belongs to and then based on this we exploit the similarities among the same technological regimes across the countries under investigation. In this way, we increase our certainty regarding a common policy perspective (i.e. Basel III), since we capture in the most accurate way any deviation deriving not only from heterogeneity in banks' activities, but from heterogeneity in banks' country characteristics as well. We must highlight here another differentiation of our study from the literature of latent class stochastic frontier and specifically in the area of banking from all the previous studies as far as our knowledge goes. We follow two different modelling strategies in order to maximize the precision of our estimates. To be more precise, we adopt both a panel data nature methodology (Orea and Kumbhakar 2004) which allows the efficiency term to vary every year and a pooled cross-section methodology (Bos et al. 2010) which permits each financial institution to switch between technology regimes over time. In this way we amplify considerably the robustness of our empirical evidence. Both strategies are compared with a model which assumes that technology is the same for all banks which we use as our baseline specification. It should be highlighted that in addition to our alternative modelling strategies, we perform various additional robustness checks, in order to ensure the applicability of our policy recommendations across a wide range of models. Also we provide a different length for our sample, since the period that we cover is the largest one compared to all the previous studies that have been compiled for the UK and Greek banking sector. The reason this is important is that our sample-period captures all the fundamental developments such as deregulation, financial liberalization and of course the recent global financial turmoil. Therefore it allows us to see the effects of both growth and recession periods in economic activity. Another contribution of major importance is that in contrast with all the previous empirical banking studies in both countries that focus specifically on one type of financial intermediary, we account for all the credit institutions of both banking systems. Thus, we are able to extract accurate inferences with crucial policy implications for the entire banking system instead of providing an ad hoc generalization of the results.

Lastly, we propose a new methodology in the spectrum of mergers and acquisitions (M&A). Our motivation comes from the big changes that have been taking place since the summer of 2012 until present in the Greek banking sector. To this effect, we try to shed light on the aspect of existing and potential mergers and acquisitions of UK and Greek banks in order to examine from an efficiency point of view whether the creation of the new bank would move to the most efficient technological regime. We also study whether this would increase the scores of the total factor productivity of the industry which would result in larger social welfare. Our main contribution are: Firstly, to provide for the first time an econometric method to evaluate and compare the efficiency gains or losses of a potential M&A activity. Secondly, to be able to extract unbiased inferences. This has major policy implications regarding the constant debate about the true origins of a M&A activity in terms of promoting the social welfare or rather managerial incentives. The latter is of extreme importance for policy makers and practitioners, since after the onset of the global financial turmoil we have witnessed numerous cases of banks' M&As world-widely and there are daily speculations about new ones, regardless of whether those financial institutions are labelled in terms of specialization as, commercial, saving, co-operative, real estate & mortgage bank or something else. With this in mind we investigate all the possible combinations of mergers and acquisitions that could occur in the two banking sectors.

Several important and interesting implications can be drawn from our empirical analysis. First in line with Orea and Kumbhakar (2004), we show that single-frontier methods employed in previous studies result in a downward-bias of efficiency estimates, since technological differences are inappropriately labelled as inefficiency. More specifically bank heterogeneity in both banking markets can be controlled when a model with two classes is estimated. This decision is supported by the AIC and BIC criterion and it comes in line with the notion that efficiency increases as the number of technological regimes increases. In both countries the financial institutions that belong to the first technological regime, which are well capitalised, possess a superior management in both credit and liquidity risk and seem to be the most efficient. Overall, the same picture is drawn when we adopt Bos et al. 2010 pooled cross-section methodology. It's noteworthy that in both countries all the credit institutions that are classified as being in the first of our two technological regimes on average earn higher rents and offer a broader variety of products and services. In line with Casu and Girardone (2006) we find that a less sophisticated banking system allows Greek banks to exercise higher efficiency levels compared to the UK ones, signalling a trade-off between complexity of services and products and aggregate efficiency. Additionally, we find evidence of increasing returns to scale for the financial institutions that belong to the second class of both countries. Nevertheless, statistical support in favour of technical progress can be associated with the UK banking sector as it seems to be rather mediocre for the Greek banks. Finally, we provide insight in favour of the "ring-fencing" strategy proposed by the Independent Commission on Banking (ICB). All these conclusions remain unchanged after we impose various robustness tests.

As far as the aspect of recent and potential M&A in the Greek and UK banking sector is concerned, important policy implications can be extracted. Regarding the Greek banking sector, we cast some serious doubts on the recent wave of consolidation and its true origins of motivation which had rather a managerial scope instead of a social economic well-being. To this extent we present empirical evidence for the deterioration of efficiency in two of the four cornerstones which have been assigned to the recovery of the Greek economy as a result of their consolidation. Regarding prospective attempts of consolidation among the two banking sectors, we conclude that there are significant economies of scale regarding the smaller in size financial institutions in both countries. Furthermore, regarding the banking institutions that belong to the second class of both countries we argue that potentially higher efficiency could be achieved as result of future M&A activity among them. In turn, we argue that the 'new' financial institutions can be better equipped to withstand potential adverse economic conditions and crucial oscillations in a future financial crisis.

The rest of the paper is organized as follows. Section 2.2 offers a background of the stochastic frontier analysis and methods to account for heterogeneous productions technologies. Section 2.3 provides an overview of the theoretical framework and presents the empirical model. Section 2.4, provides a brief overview of the main developments of each country within its respective sample period and describes the data. Section 2.5 presents and discusses the empirical evidence of applying the models to the UK and Greek banking sectors. In addition, it provides robustness tests and displays findings regarding the proposed methodology of recent and potential M&A activity in both banking systems. Some conclusions and insights for future research are offered in the final section.

2.2 Stochastic Frontier Analysis

Investigating the literature of efficiency measurement, it is evident that stochastic production (or economic) frontier functions have been increasingly used in order to measure efficiency of individual producers. Notably they seem to dominate parametric approaches (Kumbhakar and Lovell, 2000). Particularly, the Stochastic Frontier Approach (SFA) separates inefficiencies from random noise; however it needs as a prerequisite an a priori assumption on the error term. The alternative parametric techniques, such as the Distribution Free Approach (DFA) (Berger 1993) and the Thick Frontier Approach (TFA) (Berger and Humphrey 1991), may require less structure on the error term, but they impose an assumption of constant core inefficiency or do not present bank specific-point estimates. On the contrary, non-parametric techniques, while they do not impose any assumption on the error term, they do not take into consideration the random noise and in addition they have an extreme sensitivity to outliers. In the present study, following several earlier and recent as well empirical works we use SFA to estimate the efficiency of banks (Kumbhakar 1990 & 1997, Resti 1997 and Fiordelisi, Ibanez, Molyneux 2011).

The Stochastic frontier production function was independently proposed by Aigner, Lovell and Schmidt (1977), Battese and Corra (1977) and Meeusen and van den Broeck (1977) and it was applied to banking by Ferrier and Lovell (1990). It takes the following general form:

$$y = \beta' x + v - u \tag{2.2.1}$$

where y is the observed outcome (goal attainment), $\beta' x + v$ is the optimal frontier goal followed by the individual, $\beta' x$ is the deterministic part of the frontier and v is the stochastic part. Stochastic frontier is created if we combine these two parts. The aggregate amount of deviation from the optimum which lies on the frontier is what constitutes u.

Economic representations of production technology include cost, revenue and profit frontiers. These economic frontiers are then used as standards against which to measure cost, revenue and profit efficiency. As described by Kumbhakar and Lovell (2000) a cost stochastic frontier takes the form:

$$c\left(y_i, w_i; \beta\right) \tag{2.2.2}$$

and can be written as

$$C_i \geq c\left(y_i, w_i; \beta\right) \cdot \exp\left\{v_i\right\}, \qquad (2.2.3)$$

where $c\left(y_i, w_i; \beta\right) \cdot \exp\left\{v_i\right\}$ is the stochastic frontier. In the same spirit as before the stochastic cost frontier consists of two part: the $c\left(y_i, w_i; \beta\right)$ part which is the deterministic kernel and is the same to all producers and the $\exp\left\{v_i\right\}$ part which is unique to each producer and captures the effects of random shocks to each producer. To be more specific, β is a vector of technology parameters to be estimated, y_i and w_i indicate vectors of outputs and inputs prices respectively and v_i is a producer specific random disturbance. The measure of cost efficiency is then

$$CE_i = \frac{c\left(y_i, w_i; \beta\right) \cdot \exp\left\{v_i\right\}}{C_i}. \qquad (2.2.4)$$

This is the ratio of the minimum possible cost, given v_i, to actual total cost. If $C_i = c\left(y_i, w_i; \beta\right) \cdot \exp\left\{v_i\right\}$, then the firm i is fully efficient and $CE_i = 1$. Otherwise actual cost exceeds the minimum so $0 \leq CE_i \leq 1$.

A number of different functional forms are used in the literature to model production functions such as *Cobb-Douglas* which is log linear in outputs and inputs, the *Translog* function which is a generalization of a *Cobb-Douglas* function, a *Quadratic* in inputs function and a *Normalised* quadratic function. The first two are the most widely used in the literature. Assuming that the stochastic cost frontier follows a *Cobb-Douglas* function its log form representation can be written as

$$\begin{aligned} \ln \mathrm{Ci} &\geq \ln c\left(y, w_i\right) + v_i \qquad (2.2.5) \\ &= \ln c\left(y, w_i\right) + u_i + v_i \end{aligned}$$

where (u_i) is a nonnegative inefficiency component. Cost efficiency is then $CE_i = \exp\left\{-u_i\right\}$. Aigner, Lovell, and Schmidt (1977) assume $v_i \sim N\left[0, \sigma_\nu^2\right]$ and $u_i \sim N\left[0^+, \sigma_u^2\right]$. In addition to the half-normal assumption for u_i, other one sided-distributions have been used including the truncated -normal, where $u_i \sim iid\ N\left[\mu, \sigma_u^2\right]$ introduced by Stevenson (1980), the exponential where $u_i \sim iid \exp onetial$ introduced by Aigner, Lovell, and Schmidt (1977) as well as Meeusen and van den Broeck (1977), and gamma where $u_i \sim iid\ gamma$ introduced by Greene (1980 a,b) and Stevenson (1980).

2.2.1 Methods to account for heterogeneous production technologies

Estimation of a stochastic frontier cost function imposes a strong assumption that the underlying production technology is common to all producers. Neglecting the existence of different technologies in banking can contaminate efficiency, market power, and other performance measures. An important drawback of the homogeneous technological regime assumption is that it imposes restrictions on certain important characteristics of banking technology, such as technical progress and scale economies. That is the estimate of the underlying technology may be biased. Hence, unobserved technological differences are not taken into account during the estimation procedure and consequently the effects of these omitted unobserved technological differences might be inappropriately labelled as inefficiency.

Despite the on-going harmonization of regulation, very different banks continue to exist side by side. In the literature of bank efficiency we can identify two types of systematic differences across and within national banking markets. The first type of heterogeneity refers to the environment in which banks operate, which is exogenous to managers. Conditional on environmental differences, banks may employ different business models (retail versus wholesales) that require different intermediation technologies. The second type of systematic differences refers to managerial choices, especially those related to risk management, i.e. whether the bank manager takes too much or too little risk with respect to the value maximising amount, which affect the banking firm's efficiency (Kauko 2009). This second type of heterogeneity is identified as endogenous to managers and influences the ability to attain the optimum benchmark rather than the shape of the efficient frontier. In this specific framework we will use methods in the context of SFA in order to account for heterogeneous technologies in the banking system.

There are several approaches that can be employed to capture technological differences. One approach is the one introduced by Hayami and Ruttan (1970) which, based on the notion of the metafrontier, emanates from the metaproduction function. This approach still remains an extremely ambiguous notion, due to the fact that it is not conducive to the understanding of the marginal contribution of the different elements of environmental factors that might shed light on the differences in bank efficiency. Another approach is to include country-specific environmental variables that are likely to influence technologies of banks, such as the level of economic development and institutional background, as additional explanatory variables in the frontier (Bonin et.al 2005, Berger 2007). The main disadvantage of this approach is that the introduction of the environmental variables only affects the intercept of the frontier specification, leaving the slope unaffected (Bos and Schmiedel 2007). Another drawback of this approach is that technological differences are assumed to be country-specific, which rules out the possibility that banks located within the same country may employ different business models (Koetter and Poghosyan 2009). An alternative approach that attempts to relieve the impact of technological differences is a priori sample separation. The sample separation can be based, for instance on the organizational structure of banks Mester 1993; Altunbas et al. (2001), or their geographical location (Mester 1996; Bos and Schmiedel 2007; Claessens et.al 2001). In this approach the main disadvantage is that a priori restriction of sample separation is to some extent arbitrary. For instance, Koetter and Poghosyan (2009) show that even banks having similar organizational structure can operate under different technological regimes.

2.3 Theoretical Framework-Latent Class Stochastic Frontier Model

In this study, we account for differences in technological regimes using a latent class stochastic frontier model (LCSFM), which addresses the disadvantages associated with the aforementioned alternative approaches. Unlike the first of these approaches, the impact of the environmental factors is not only reflected in the magnitude of the intercepts, but also affects the slope coefficients. Hence, we can have two different impacts on the stochastic frontier. First we may have parallel shifts of the frontier and second we may have systematic different deviations from the frontier. Specifically, the environmental variables enter as latent class determinants rather than as a part of the frontier and thus influence both estimates of the technological regime of banks and their cost efficiency simultaneously. Unlike the second approach described in the previous section, the latent class method does not require a priori grouping of banks. Instead, it utilizes all information available in the sample and identifies separate technological regimes based on the maximum likelihood principle. There are some notable contributions in the literature that combine mixed latent class principles with the SFA. One strand of the literature consists of a Bayesian approach in allocating firms to different technological regimes. To be more precise Tsionas and Kumbhakar (2004) propose a stochastic frontier production function augmented with a Markov switching structure to account for different technology parameters across heterogeneous countries. Another strand lies in the principles of Maximum Likelihood approach. Specifically, Greene (2002) proposes a maximum likelihood LCSFM using sample separation information and allowing for more than two classes. Another noteworthy study as well the study is Gaudill (2003)[6] who proposes an expectation-maximization (EM) algorithm and without having sample separation information, he estimates a combination of two stochastic cost frontiers (see Greene 2001). Both of the previous studies do not allow to the efficiency term to vary every year, which is an important drawback when we conduct productivity growth studies. This obstacle is surmounted in our analysis, as we use panel data LCSFM for the estimation of our latent class efficiency determinants. This is an approach employed in banking studies by Orea and Kumbhakar (2004), Koetter and Poghosyan (2009) and Poghosyan and Kumbhakar (2010). These three studies assume that every bank in the sample remains in the same technological regime for all the years it operates (Bos et al. 2010). Due to these methodological issues a novelty of our study is that it uses two methodologies proposed in the literature. Firstly, we apply the one showed by Orea and Kumbhakar (2004) which allows for a time-varying efficiency term. Secondly, as a robustness check of our estimates we apply the methodology followed by Bos

[6] In addition see, Beard et al. (1997), for studies which use a non-frontier approach.

et al (2010), which permits the financial institution to be in one regime a specific year and in another regime the year after. Thus, the first methodology adopts a panel nature whereas the second one treats the data set as a pooled cross-section. To the best of our knowledge, this is the first time in the latent class stochastic frontier literature that both models would be applied in order to answer the same research question. Thus, we manage to surmount several modelling limitations and we are able to produce both the most accurate comparison and inferences.

In the determination of efficiency, the technology of banks belonging to each class (i.e. technological regime) must be modelled. Following Orea and Kumbhakar (2004), we assume that the technology is represented by a cost function. This may be written for class k as

$$\ln C_{it} = \ln C(y_{it}, w_{it}, t\ ; \beta_k) + u_{it|k} + v_{it|k}, \tag{2.3.1}$$

where subscripts $i = 1, ...N$, $t = 1, ..., T_i$ and $k = 1, ..., K$, stand for bank, time and class respectively. C_{it} is individual bank total cost; y_{it} and w_{it} indicate vectors of output and input prices; β_k is a class-specific vector of parameters to be estimated. The two-sided random error term $v_{it|k}$ is assumed to be independent of the non-negative cost efficiency variable $u_{it|k}$ for each class. Here the technology is represented by a dual cost function.

To estimate the model using maximum likelihood we assume that the random error term for class $k, v_{it|k}$, follows a normal distribution with zero mean and constant variance, $\sigma^2_{vk.}$ and the non-negative inefficient component follows a normal-half normal distribution.

The likelihood function (LF) for firm i, at time t belonging to class k is (see Battese and Coeli 1992 and Greene 2005):

$$LF_{ikt} f\left(C_{it} \mid x_{it}, \beta_k, \sigma_{k,} \lambda_k\right) = \frac{\phi\left(\lambda_k \cdot \varepsilon_{it|k}/\sigma_j\right)}{\phi\left(0\right)} \cdot \frac{1}{\sigma_k} \cdot \phi\left(\frac{\varepsilon_{it|k}}{\sigma_k}\right) \tag{2.3.2}$$

where, $\varepsilon_{it|k} = \ln C_{it|k} - \beta_j' x_{it}$; $\sigma_k = \left[\sigma_{vk}^2 + \sigma_{uk}^2\right]^{\frac{1}{2}}$; $\lambda_k = \sigma_{u|k}/\sigma_{\nu|k}$; λ_k parameter is the ratio of the standard deviation of the one-sided inefficient component to the standard deviation of the two sided random error, and ϕ and $\phi\left(0\right)$ denote the standard normal density and cumulative distribution function respectively.

The unconditional likelihood of bank i where $\theta_k = \left(\beta_k, \sigma_k^2, \lambda_k,\right)$ are the parameters associated with the technology of class k, is obtained as a weighted sum of the k-class likelihood functions, where the weights are the class membership probabilities reflecting the uncertainty regarding the true membership in the sample[7] :

$$LF_i\left(\theta, \delta\right) = \sum_{k=1}^{K} LF_{ik}\left(\theta_k\right) \cdot P_{ik}\left(\delta_k\right) \tag{2.3.3}$$

where $0 \leq P_{ik} \leq 1$ and $\sum_{k=1}^{K} P_{ik} = 1$

We can parameterize the class probabilities by employing the multinomial logit model:

$$P_{ik}\left(\delta_k\right) = \frac{e^{\left(\delta_k^{|} q_i\right)}}{\sum_{k=1}^{K} e^{\left(\delta_k^{|} q_i\right)}} \tag{2.3.4}$$

where $k = 1, ..., K$, denotes classes; $\delta_k = 0$ is a parameter normalization for the reference class and q_i is a vector of bank-specific and time-invariant class determinants.

Combining equations (2.3.2) and (2.3.4), the overall likelihood function is a continuous function of the vectors of parameters θ and δ and

[7] For the sake of brevity, we note that in the robustness section when we use the methodology of Bos et al.(2010), our notation in the following equations, slightly changes and when we write 'i|k' which indicates the financial instituition conditional on being in class k, we mean instead, 'it|k', indicating that the financial insitution at specific time t conditional to class k, since we treat each specific observation as independent throughout the years for each credit institution.

is indicated as:

$$\ln LF(\theta,\delta) = \sum_{i=1}^{N} \ln LF_i(\theta,\delta) = \sum_{i=1}^{N} \ln \left\{ \sum_{k=1}^{K} LF_{ik}(\theta_k) \cdot P_{ik}(\delta_k) \right\} \tag{2.3.5}$$

Note that in order to identify the parameters of latent class probabilities, the sample has to be generated from different technological regimes in which the banks are operating. Therefore, the number of classes (k) should not exceed the number of true regimes in the sample, otherwise the parameters cannot be identified.

The estimated parameters can be used then to compute the conditional posterior class probabilities. Greene (2002) showed that the posterior probability of class-k membership for bank i can be computed as:

$$P(k \mid i) = \frac{LF_{ik}(\theta_k) \cdot P_{ik}(\delta_k)}{\sum_{k=1}^{K} LF_{ik}(\theta_k) \cdot P_{ik}(\delta_k)} \tag{2.3.6}$$

Unlike the standard stochastic frontier approach, where the cost frontier is the same for each bank, in the latent class stochastic frontier model we estimate several frontiers (equal to the number of classes).

What remains to be estimated, is the cost inefficiency term in the case when we have several benchmarks (i.e. technological regimes). According to Greene (2002), we can achieve that by getting the weighted average of the cost inefficiency terms:

$$\ln EF_i = \sum_{k=1}^{K} P(k \mid i) \cdot \ln EF_i(k), \tag{2.3.7}$$

where $EF_i(k)$ is the bank's cost efficiency using class-k technology as a reference. In this case technologies from every class are taken into account when estimating the cost efficiency.

2.4 Data

2.4.1 UK & Greek banking market

We now turn to our data characteristics. For the estimation of the model we use data that consist of an unbalanced panel of all the financial institutions that provided credit[8]during the years 1988-2011 in the UK and 1993-2011 in Greece[9]. Overall, both our samples account for a significant market share in terms of assets, loans and deposits, occasionally even more than 90% in each respective category in both countries. More precisely, the UK sample comprises 2,324 observations for 162 financial institutions, whereas the Greek sample consists of 30 financial institutions with a total of 356 observations. The main difference between the two banking sectors is that 'Commercial' banks incorporated in Greece are the dominant group in the banking system. The dominance of commercial banking can also be confirmed by the number of branches and employees. Greek commercial banks have 3,302 branches in operation (out of 3,575 for all credit institutions which is equivalent to 92.36%), while the number of their employee's stands at 51,012 (out of 56,611 employed in all credit institutions which is equivalent to 90.11%) according to the Hellenic Banking association (2011).

During the years studied important structural changes and developments occurred awithin the European Union countries and world-wide which influenced both countries' financial systems. We experienced the

[8] Our sample consists of Commercial banks, Real Estate and Mortgage Banks, Bank Holding Companies, Cooperative Banks and Savings Banks.

[9] The reasoning behind selecting 1993 as the starting year for the sample regarding the Greek banking sector is becauce in that year the full liberalization of the Greek banking system occured. This followed the provision of the Second Banking Directive regarding establishment, supervision and operation in 1992 by the Basic Banking Law Banking Directive.

introduction of the Economic and Monetary Union (EMU), the macroeconomic stabilization programme, the establishment of advanced information technologies and the internationalization of banking activities, which enhanced competition in both price and quality levels. Important changes took place on a domestic level as well. Regarding the Greek banking sector, the most important development, was the establishment of 'Euro' as the country's common currency and sole legal tender[10]. Additionally, a major structural feature of the Greek financial system, characterizing in particular the old banking regime, is the significant level of state intervention, which for a long time hindered competition and created a distorted market environment. In the early 1990s, the state commercial banks controlled around 85 per cent of total commercial banking operations. Since then, a notable trend observed in the Greek banking sector commenced with the privatization of several banks controlled by the Greek state, which contributed to the enhancement of competition in the market. That said, the country's banking sector has a Herfindahl index figure of 1,278 , higher than the average European Herfindahl index which is 1,102 for the 27 countries members of the European Union (1,195 for the 17 countries members of the European Monetary Union) (European Central Bank, 2011), which highlights a picture of a concentrated banking sector. Finally, during the first half of the 1990s, new private-owned foreign commercial banks were established, taking advantage of new products and services that were not available in the Greek market just a decade ago.

Turning to the UK banking sector, it is noteworthy that the building society sector, having continued to expand during the 1980s and 1990s, saw a sharp contraction in the mid-late 1990s, as many building

[10] Greece joined the Eurozone in 2001. Currently, 17 out of the 28 members of the European Union use the Euro as their national currency.

societies demutualised and became banks. Another major development saw the largest UK banks become truly universal banks, by expanding the range of their activities and services. Specifically, now they encompass securities underwriting and trading, fund management, derivatives trading and general insurance. This expansion coincided with a period of significant growth in securities markets and the markets for foreign exchange and derivatives. It must be highlighted that on aggregate, UK banks' balance sheets account for more than 500% of annual UK GDP, a development that occursed mainly in the 2000's.

Looking at common trends existant in both countries during the last years of our sample, we note the significant credit expansion, as the level of loans to loss provisions increased considerably. One could argue that the signs of the financial turmoil were becoming apparent. Indeed the six largest banks in both countries in the end of 2011 accounted for more than 80% of each country's financial system.

As it was noted earlier a novel feature of our study is the period that is being covered, which is the largest of all the previous ones that have been elaborated in both financial systems. The number of banks that we examine in our study changes during the sample period in both countries. This occurs specifically in Greece due to many M&As that took place in the end of the 90's. The observed wave of mergers and acquisitions was triggered primarily by the willingness of the small banks to obtain a higher market share and secondarily by the privatization process which was initiated by the government, in line with the second Banking Directive. At the end of 2011, the Greek banking system was dominated by six leading large banks in terms of assets, deposits and loans (Ethniki bank – also known as National bank of Greece, Alpha bank, Eurobank, Piraeus bank, Emporiki bank- also known as Commercial bank and Agricultural bank)[11], which altogether held 74.6 per cent of the market share, a figure higher than the average European concentration ratio calculated by the market share of the five largest banks in each country (CR5). This stands at 59.6 per cent for the 27 countries members of the European Union (Greece has 72.0 per cent) and 58.1 per cent for the 17 countries members of the European Monetary Union (European Central Bank, 2011). On the contrary in the UK, despite the fact that the market is dominated as in the case of Greece, by six dominant financial institutions as (Barclays bank, HSBC bank, RBS bank, Lloyds bank, Santander bank and Nationwide Building society), the banking sector is less concentrated.

In Tables 2.1.a-2.1.b and 2.2.a-2.2.b, we report representative figures of the UK and Greek financial institutions used in both our samples respectively. More specifically, tables 1a and 1b offer an overview of some important banking indicators of the UK and Greek banking sector for the whole period of our study, whereas tables 2a and 2b report an insight on the UK and Greek financial intermediaries for each year of our sample.

2.4.2 Model Specification

The latent class stochastic frontier model (Orea and Kumbhakar 2004) presented in the previous section requires the following three sets of variables to be determined:

- Kernel determinants: (C, y, w, eq, t)
- Inefficiency determinants: z
- Class membership determinants: k

[11] In the Greek banking sector a bank is classified as "large" if it holds total assets above 20 billions in euro in 2011.

Kernel determinants

A critical discussion of the two mostly used approaches for measuring and defining inputs and outputs has been done by Berger and Humphrey (1997). They conclude that despite the fact that none of them is ideal, the production approach is preferable when we want to evaluate the efficiency of branches of financial institutions, whereas the intermediation approach is preferable when we want to analyze the efficiency of the whole financial institution. Therefore, in line with the vast and established literature regarding the determinants of cost efficiency in banking (Berger 2007), we specify the cost kernel components that represent the intermediation approach of banks used by Sealey and Lindley (1977) to define inputs and output[12]. In the present study we specify the two mainstream types of outputs as total loans (y_1) and total earning assets (y_2) , which is defined as the sum of investment assets, securities and other earning assets. However, as Stiroh (2004) emphasizes, fee income is increasingly becoming a substitute for the revenues that can be earned on narrowing interest margins in the classical intermediation business. To account for this development, we also account for total off-balance sheet activities, credit commitments and derivatives, as an additional output(y_3)[13]. Additionally, we specify as our three types of inputs: (1) the total intermediated funds (F), which consists of savings accounts, current accounts, time deposits, repurchase

[12] The key difference between the two approaches, is that production approach treats deposits as outputs, whereas intermediation approach treats them as inputs.

[13] Numerous banks around the world have broadened their portfolio to offer non-traditional services. Additionally, off-balance sheet (OBS) activities such as securitization, loan origination, derivative securities, and standby letters of credit among others have been expanding at a rapid pace. As a result, the share of fee-based and other non-interest income to total income has increased dramatically.

agreements and alternative funding sources, (2) the labour (L), which refers to the manpower involved in the operations of the all the credit institutions in the sample and (3) the physical capital depreciation and amortization (K), which consists of fixed assets, including tangible fixed assets (land, buildings, office equipment, etc., less depreciation) and intangible assets (software, underwriting expenses, research expenses, etc.). Furthermore, following Berger and Mester (1997), we specify equity as a quasi-fixed input to control for differences in risk preferences, which may arise due to regulation, financial distress, or informational asymmetries [14]. Raising equity is associated with higher costs than raising deposits and the mix of these liabilities can have a direct impact on cost (Berger and Mester, 1997). As dependent variable we use total cost (TC) which is defined as the sum of personnel and administrative expenses, interest fee and commission expenses. Finally, we include a time trend determinant (T) to capture the potential technical change that occurred during the examination period for each financial institution. Note that inputs and outputs increased by a considerable amount during the years of our samples, due to the growing size of the both domestic and foreign credit institutions and due to the rising level of M&As. We measure the price of input (w_1) by using the ratio of interest expenses to total deposits and short term funding. Also we measure the price of input (w_2) by using the ratio of staff expenses to total assets. Lastly we measure the price of input (w_3) by using the ratio of fee and commission expenses added to administration expenses to fixed assets. As for the measurement of the quasi-fixed input variable, we measure (eq) by using the amount of equity capital that consists of

[14] Berger and Mester (1997) argue that not accounting for equity can result in a scale bias, while the efficiency of banks could be miscalculated even if they behave optimally given their risk preferences.

common equity, non-controlling interest, securities revaluation reserves and other accumulated comprehensive income.

Following the majority of empirical studies in banking, we obtain the largest part of our annual bank-level data from the Bankscope database of Bureau Van Dijk's company. Any missing information is filled in from the official websites of UK and Greek financial institutions, by the British British Bankers and Building Societies Association, the Hellenic Bank Association, and by the annual reports of both the governors of Bank of England and of Bank of Greece.

At this point we highlight a number of crucial points that we take into account in our data selection strategy. This strategy is of major importance in terms of accuracy of the results and of the inferences based on them. Regrettably it has been mistakenly disdained by the bulk of the empirical studies that have used Bankscope database (see Claessens and van Horen, 2012 and Clerides et. al 2013). To be more precise, first, we check both samples for double-counting observations. Bankscope provides company account statements for banks and financial institutions across the world by collecting financial statements with both consolidation and unconsolidation status. We select the unconsolidated data[15] and exclude the equivalent consolidated data to avoid double counting the same financial institution.

As a second step, we take into consideration mergers and acquisitions (M&A). For this purpose we conduct a thorough check through all M&A activities that took place in the past in both banking sectors so that only the merged entity or the acquiring bank remains in the sample after a take-over. As an intuitive example: assume that bank A and bank B merged in 2003 to create a new entity, bank C, then the

[15] In cases where unconsolidated data were not available, we chose consolidated data instead.

two individual banks A and B are each included in the dataset until 2003. From 2003 onwards, these two banks' operations are considered to be terminated and the new bank (bank C) is included in the database. In the same spirit, assume that bank A was acquired by bank B in 2003; both banks are included in the database until 2003, with bank A then becoming inactive after 2003 and bank B remaining active after 2003. We obtain detailed information on mergers and acquisitions from Zephyr database of Bureau Van Dijk's company.

All data are deflated using each country's GDP deflator (using 2005 as the base year) obtained from the World Bank database and converted to US Dollars. In addition to the two considerations in our data filtering process, we exclude observations of missing, negative or zero values for inputs/outputs and control variables. Our final samples account for 124 financial institutions and 1856 observations for the UK banking sector and for 30 financial institutions and 356 observations for the Greek banking sector.

Inefficiency determinants

Turning our attention to the parametric part of the inefficiency component, we consider three z_{it}variables, for each banking sector.

Time The first variable is *time* indicating spillover effects from recent developments such as deregulation processes and transfer of know-how. The parametric component becomes a function of time with only one parameter. In turn, efficiency either increases, decreases or remains constant. We use time-trend to measure time.

Size The second variable is *size* reflecting recent debates concerning the optimum size that a financial institution should have. In general this variable is supposed to have a positive effect on efficiency as it increases to a certain level. Nevertheless, the impact of an extremely large size can be proved to be counterproductive for the credit institution's efficient operation. According to empirical findings the relationship between efficiency and size is not linear. We use each bank's real assets in order to measure this determinant.

Type & Ownership The third variable is different for each country. In the UK we recognize that two different types of financial institutions dominate the provision of credit: banks and building societies. For this purpose we create a dummy variable, *bs,* which takes the value 1 if the financial institution is a building society and 0 otherwise. Regarding the Greek banking sector, as mentioned earlier, a key development that we take into account is the increase of the number of the private-owned institutions. We check the impact of privately and publicly-owned or government-owned banks on bank efficiency. Efficiency of the banking industry can benefit from the fact that privately-owned banks perform more efficiently compared to their rivals, who often operate on different business plans due to the meddling of politicians in the bank's affairs. (see Laporta, Lopez-de-Silanes and Shleifer 2002). There is empirical evidence supporting this hypothesis especially during the period in which the share of the publicly-owned banks is very high and their performance is of critical importance for the Greek financial system (Delis et al 2009). We control for the effects using a dummy variable *owner* which takes the value 1 if the depository institution is privately-owned and 0 otherwise.

Class membership determinants

We consider the firm-average value of five variables, apart from an intercept, as determinants of the latent class probabilities.

Capital adequacy Examining the annual reports of the governors of both countries' central banks, we notice that the financial institutions are quite heterogeneous in terms of capital requirements. According to the literature, credit institutions which have a significant amount of capital are considered more stable, can employ high cost plans in order to ameliorate their economies of scope and are able to achieve this in a safer way by reducing the potential risks. Furthermore, they can adjust easier to unexpected developments. Also shareholders of banks which are well capitalized can reduce moral hazard by controlling more closely the bank's management. We expect the most efficient banks to have higher levels of capital. In order to measure the capital adequacy we use the equity to assets ratio.

Liquidity risk The recent financial turmoil demonstrates the severe impact that this risk can have on the financial system. Clearly, credit institutions with high liquidity are able to expand and/or face potential adverse conditions in the economic environment better than those that need to resort to stock markets to raise funds, especially at times of worsening conditions in money markets as the one we experienced in the recent financial turnmoil. Although liquidity risk can be measured in different ways we follow the approach by Altunbas et al. (2000) and measure it by the loans to assets ratio. The higher this ratio, the greater the need of the financial institutions to raise finance.

Credit risk The specific determinant reflects a very important risk that depository institutions confront. An indication of the quality of the credit risk management of the institution stems from the level of this risk, given that high values of it are associated with a less efficient functioning of lending procedures (Berger and De Young, 1997). That said credit institutions seeking higher rents undergo in risky projects in expectation of higher yields. Also it can be the case where borrowers face difficulties to meet their obligations due to unexpected adverse economic developments. Thus a high value of credit risk may not be attributable to poor management. Additionally, a financial institution may choose a strategy which reflects reduced efforts in granting and monitoring loans that may appear cost efficient, but has an increased credit risk. We measure this specific category of risk by each bank's flow of provisions to total assets ratio.

Service Concentration We stress the different strategies that credit institutions follow to create their products. We carefully examine the income statements and identify substantial differences in the level of loans, securities, investment assets and off balance sheet activities. For this purpose we measure each financial institution's degree of specialization. We argue that there exists a trade-off between the variety of products and services that a bank offers and its efficiency level since in this case it requires a more specialized management. We measure it as the sum of the squared ratios of the value of each output to the total value of outputs of each financial institution.

Profitability All depository institutions' annual income statements disclose tremendous differences regarding their profitability. This determinant can have opposite effects depending on which economic efficiency is the subject of interest. High profitability allows banks to invest in improved technology and in skilled personnel with higher wages as they expect this to bring in much higher output gains and consequently, higher profit efficiency. However, higher wages and investments in advanced technology would mark an increase in costs, resulting in a decline of cost efficiency. We proxy the specific variable by the ratio of pre-tax profits to assets (ROA).

Table 2.3.a, 2.3.b, presents descriptive statistics of the variables that we use in the estimation of the cost frontier kernel, the inefficient component and the regime class membership for the UK and Greek banking sector respectively[16]. Even though we use natural logarithms of variables in the cost kernel components (these represent the intermediation technology) in order to compute the efficiency scores, we show the mean and standard deviations in levels to be more informative.

The final specification of our latent class cost stochastic frontier model takes the following log-linear form which represents a logarithmic transformation of a Cobb-Douglas production function [17]:

$$\ln TC_{it|k} = \beta_{0|k} + \sum_{l=1}^{3} \beta_{yl|k} \ln y_{it,l} + \sum_{s=1}^{2} \beta_{ws|k} \ln w_{it,s} + \beta_{eq|k} \ln eq_{it} + \beta_{t|k} T + u_{it|k} + v_{it|k} \tag{2.4.1}$$

where, $k = 1, ..., K$, expresses class membership.

Inefficiency is modelled as a function of its determinants[18]:

$$u_{it|k} = \exp^{[\eta_{1|K} TIME + \eta_{2i|k} SIZE + \eta_{3i|k} BS} \tag{2.4.2}$$

[16] We don't include the two dummy variables.

[17] We apply Specification tests in both countries and the results reject a translog in favour of a Cobb-Douglas cost function.

[18] We note here that in the second methodology (Bos et al. 2010) that we employ as a robustness check, inefficiency is not modelled as function of its determinants. Only the class membership probability is.

1and

$$u_{it|k} = \exp^{[\eta_{1|K}TIME + \eta_{2i|k}SIZE + \eta_{3i|k}OWNER} \tag{2.4.3}$$

for the UK and the Greek banking sector respectively.

$TIME, SIZE, BS, OWNER$ refer to a *time-trend* variable, the *size* (in terms of assets) of each financial institution, a dummy variable reflecting the *type* of each UK financial institutions and the *ownership* of the Greek banks respectively.

The latent class probabilities are specified as:

$$P_{ik}\left(\delta_k\right) = \frac{e^{\left(\delta_{ok} + \delta_{1i|k}CAP\_ADEQ + \delta_{2i|k}LIQ\_RISK + \delta_{3i|k}CRED\_RISK + \delta_{4i|k}SERV\_CON + \delta_{5i|k}PROF\right)}}{\sum_{k=1}^{K} e^{\left(\delta_{ok} + \delta_{1i|k}CAP\_ADEQ + \delta_{2i|k}LIQ\_RISK + \delta_{3i|k}CRED\_RISK + \delta_{4i|k}SERV\_CON + \delta_{5i|k}PROF\right)}} \tag{2.4.4}$$

where $CAP\_ADEQ, LIQ\_RISK, CRED\_RISK, SERV\_CON, PROF$ refers to *capital adequacy, liquidity risk, credit risk, service concentration* and *profitability* of each financial institution in both samples.

At this point we point out that the estimated cost frontier must satisfy the following regularity conditions in order to ensure that is well behaved.[19] There should be monotonicity and concavity in input prices. These two characteristics can only be checked after the estimation procedure of the model, whereas an additional one, linear homogeneity in input prices, has to be imposed a priori. The latter property requires:

$$\sum_{s=1}^{3} \beta_{wsk} = 1 \tag{2.4.5}$$

Since the cost function is homogeneous of degree one in input prices, linear homogeneity restrictions are imposed on all price and cost vari-

[19] Because of the sample size limitations, the time trend T is not specified to interact with outputs $y_{it,l}$ and input prices $w_{it,s}$. Accordingly, only the impact of the neutral technical change on the cost function is considered in this paper, whereas the relevant impact, if any, of the non-neutral technical change is not identified.

ables with respect to one of the input prices. Here we use the price of the physical capital depreciation and amortization (w_3) as a numeraire.

2.5 Empirical results

2.5.1 Determination of the number of classes

One of the most important points in the estimation of the latent class models is the determination of the number of classes. A key method in the literature of the standard latent class models for identifying the number of regimes is the computation of an information criterion. The two most widely used statistics are the AIC (Akaike) and BIC (Schwartz) criteria. These criteria evaluate the goodness of fit of the model by imposing a penalty on the numbers of parameters in the model. They can be used to compare models with different number of classes. The preferred model is the one with the lowest statistic.

The two statistics are computed as:

$$AIC\left(K\right)=-LN\left(\sum_{i=1}^{N}\sum_{t=1}^{T_i}\left(\sum_{k=1}^{K}p\left(k\mid i\right)\cdot\varepsilon_{it}^{2}\left(k\right)\right)\right)+\ln\left(\sum_{i=1}^{N}T_i\right)+\frac{2\pi\left(K\right)}{\sum_{i=1}^{N}T_i}$$

$$BIC\left(K\right)=-2\cdot\ln LF\left(K\right)+\pi\left(K\right)\cdot\ln\left(\sum_{i=1}^{N}T_i\right)$$

where K, is the number of classes, $\pi\left(K\right)$ is the number of parameters to estimate for specification with K latent classes and T_i is the number of observations for bank i.

Tables 2.4.a and 2.4.b report the AIC and BIC values for the UK and Greek banking sectors respectively. Comparing a pooled model, i.e. the baseline model as it was described in section 2.3, which assumes homogenous production technology for all the financial institutions in the sample, i.e. $k = 1$, and a model with two different technological regimes, i.e. $k = 2$, the values of both criteria indicate that the preferred model in both countries is the one with two classes[20]. To illustrate this result, in figures 2.1.a and 2.1.b we plot the kernel density estimates of the variance of the residuals of inefficiency for both models for UK and Greece respectively. A leftward movement of the kernel in the second model with two technological regimes can easily be seen, implying that the inefficiency is removed when taking into account bank-heterogeneity. Specifically the sample is split by setting 17 and 73 banks in the first technological regime and 13 and 51 in the second one for the case of Greece and for the case of UK respectively.

In order to check the sensitivity of the class size selection to inefficiency, we compute the average efficiency scores for each year, which are obtained by estimating models with one and two technological classes. These are reported in table 2.5.a for UK, and 2.5.b for Greece. One can see that the average efficiency monotonically increases with the number of classes. In turn, this suggests that if bank heterogeneity is not taken into account, this omission can lead to downward-biased efficiency score estimates.

[20] We tried to estimate a model with more than two classes as well. For the case of the Greek banking sector it failed to achieve convergence indicating the model is over-specified. However, for the UK banking sector neither multicollinearity nor over-specification prohibits convergence of the maximum likelihood estimator. That said, parameters are jointly not significantly different from zero and the number of observations in the additional regime is very small.

2.5.2 Which technological regime is the most efficient?

Tables 2.6.a and 2.6.b, report average cost efficiency estimates using the highest probability cost frontier as a reference technology with respect to UK and Greece. It is revealed that for both countries the first technological regime consists of banks which exhibit higher cost efficiency levels than the second one. A graphical illustration of the kernel density estimates of the variance of the residuals of inefficiency of both a pooled model and of a two latent classes model for both countries is provided in figures 2.1.a and 2.1.b. It is apparent a leftward movement of the kernel in the model that assumes two latent classes, implying that the inefficiency has been removed by taking into account bank-heterogeneity.

It is noteworthy to highlight that in 2007 for UK and 2008 for Greece, efficiency level started to decline at the highest rate during both of the sample periods. This coincides with the dawn of the global financial crisis in August 2007 and the turmoil of the global money markets that followed and reached the point of eruption with the collapse of the Lehman Brothers in September 2008. Specifically for the Greek banking sector the major decline in efficiency comes after the most successful year in terms of cost efficiency. In addition, after a decrease of 2002-2003, we note a considerable increase of the efficiency estimates of the Greek banks at the end of 2004. This increase might be justified by the fact that a wave of M&A activity during 1998-2002 had been recently completed and the gains of synergies might have been realized. On the other hand, in the UK banking sector the results show the 90's to have been a decade of amelioration and development. This can be seen as well from the low level of loans loss provisions (see table

2.2.a). This should not come as a surprise since those years come after a period which saw the introduction of computing, credit cards, new sophisticated services, refurbished antiquated premises and the introduction of further technologies such as ATM and many new services which continue to drive the expansion of banks.

Another fact that is worth mentioning is that the financial crisis came with a greater time lag in Greece than in the UK and in the majority of countries that belong to the European Monetary Union(EMU). A reason for this is that Greek banks' strategies were mostly focused on a retail rather than an investment nature of banking activities, as in the case of other EU banks. This caused huge marked-to-market losses related to toxic assets. An overall comparison of all the banks in both banking systems for the entire common sample period (1993-2011) reverberate the fact that Greek banks operate under higher efficiency levels than their European counterparties albeit their more sophisticated systems, a result which in line with Casu and Girardone (2006). The answer to this conundrum could be lying in the simplicity of activities and in the smaller size of the Greek banking sector. A point which has triggered various debates lately related to the diversity of banking activities and the complexity of financial systems.

Additionally, in tables 2.6.a and 2.6.b, we observe essential divergences for every year in efficiency estimates within the two classes in both the UK and the Greek banking sector respectively. More precisely, the average level of efficiency in the first technological class for Greece is close to 82 per cent, whereas in the second technological class is close to 66 per cent. The gap within the two regimes is even larger in UK. Specifically, around 70 per cent to only 41 per cent is the overall efficiency of class one and class two respectively. Therefore, we highlight that the first technological regime in both banking systems consists of financial intermediaries that exhibit, on aggregate, higher cost efficiency levels compared to those that belong to the second latent class. Overall, we must note that in the whole sample and in both technological regimes, Greek banks are found to be very efficient, which is line with Pasiouras (2008) findings, who states that the efficiency of the Greek banks increases when we account for credit risk. UK banks have a low to moderate cost efficiency which is line with Xiang et.al (2011).

2.5.3 Determinants interpretation of heterogeneous technologies

The parameter estimates of our LCSFM are presented in tables 2.7.a and 2.7.b for the case of the UK and of Greece respectively and are estimated by maximum likelihood estimation using NLogit 5 (Greene 2009). All the variables are normalized by their respective geometric mean. Thus, the Cobb-Douglas form represents a first-order Taylor approximation around the geometric mean, to any generic cost frontier. In both countries the estimated cost frontier elasticities are found to be positive, in turn the estimated cost frontiers are increasing in input prices and outputs. The signs of the parameter estimates of the variables which are included in the kernel suggest that the monotonicity and concavity properties are satisfied. In most cases the estimated parameters of the efficiency frontiers are significant at the conventional confidence levels. From these two tables we note that in both technological regimes of the two different banking systems the estimated λ parameter is statistically insignificant, in contrast to a model that assumes homogeneous production technology[21], suggesting that bank-heterogeneity is fully controlled when a model with two classes is estimated.

Next, we examine the results that emanate from determinants that affect the inefficiency component. As far as the UK banks are concerned we notice that in the first technological regime efficiency increases over time, whereas there is an attrition of efficiency throughout the years in the second one. This can be seen from the positive sign of the statistical significant determinant (i.e. TIME) in class two; inefficiency increases during the years of the sample. The significant and negative effect that size has on efficiency prevails in both classes but there is a mixed effect of the nature of a financial institution in the two regimes. More precisely the dummy variable BS does not have any significant effect in the second class; nonetheless, it has detrimental negative effect on efficiency if the financial institution is a bank and not a building society[22].

As far as the Greek banks are concerned, we notice a convergence among the two different regimes in terms of the sign and the significance of the effect that size has on efficiency. Albeit the similarity of estimates for the first technological regime of Greek banks, the time determinant has exactly the opposite effect on efficiency compared to the UK regarding the banks that belong to the second technological regime. Lastly, we highlight that ownership has no important effect on the efficiency of banks, regardless of their classification among the two

[21] When the same production technology is assumed for all the banks in the sample the estimated λ parameter is 3.513 with a t-value of 2.765 for UK and 3.981 with a t-value of 3.593 for Greece.

[22] 'BS' is a dummy variable that takes the value 0 if the financial institution is a bank and the value 1 if it is a building society. In turn, the higher the value of BS the less (more) the level of ineffciency (efficiency).

regimes.

Subsequently, we shed light on differences of technology regimes based on the posterior production variable distributions. For both countries the majority of determinants are statistically significant, indicating that they are rudimentary for classification of banks among the two regimes. Analysis of the class determinants in terms of their sign and their statistical significance suggest that in the UK banking sector the first technological regime is very likely to consist of banks with a strong capital base, with a high quality of both their credit and liquidity risk management and a broader scope in product provision. This outcome is in line with the main principles of the Basel II accord regarding the adequate level of capital that each bank must hold in their balance sheets in order to become more efficient. On the contrary, banks not adequately capitalized, who undertake risky projects, with parsimonious liquidity but with increased service specialization are likely to be found in the second latent class. The effect of profitability is lukewarm.

Turning to the Greek banking sector, we notice that the banks that belong to the different latent classes exhibit similar characteristics in terms of capital and the level of both credit and liquidity risk they undertake as the UK banks in the same regimes. The primar difference between the two classes and in essence between the two countries, is that not only profitability but credit risk has an innocuous effect on the classification process of the Greek banks.

2.5.4 Economic interpretation of heterogeneous technologies

In order to reveal the economic intuition of the results, we compute two auxiliary measures based on the estimated frontier parameters, economies of scale and technical change and present them in tables 2.8.a and 2.8.b with respect to UK and Greece. As far as the first measure is concerned, it is computed as one minus the sum of elasticities of total costs with respect to outputs $\left(SCE = 1 - \sum_k \frac{\partial \ln C}{\partial \ln y_k}\right)$.The results indicate the presence of statistically significant increasing returns to scale for the financial institutions that are allocated in the second class of the two countries. Specifically, we find a level of 13.6% and 9.6% for Greece and the UK respectively. This finding comes as no surprise since inefficient banks can become more efficient if they expand in terms of scale. Nevertheless, it is worth mentioning that the Greek banks that belong to the first technological regime reveal a level of 5.3% of increasing scale economies, in contrast with their Europeans counterparties of the same regime where there are no significant scale economies. This result is in line with previous banking studies for Greece (Apergis and Rezitis 2004). As far as the second auxiliary measure is concerned, the intuition behind it lies in the fact that variations in cost over time that are not explained by other explanatory variables, are due to exogenous technical change computed by the derivative of total costs with respect to time $\left(TC = \frac{\partial \ln C}{\partial t}\right)$. A negative sign for this measure implies technological progress, because it assumes decrease in banks' costs over time. UK banks, despite the fact that in the second regime there is a mild (10%) statistically significance, show significant technical progress regardless of their classification, which is in line with Casu et al.(2004). In Greece on the contrary, only the financial institutions that belong to the first technological regime reveal a statistically significant technological progress, and this is in line with Pasiouras et.al.(2008).

2.5.5 Identification of heterogeneous technologies

Finally, the classification of the banks into the two technological regimes is diplayed in tables 2.9.a and 2.9.b for the UK and Greek banking system respectively. The empirical evidence reveals that for both countries each regime consists of institutions of similar characteristics, despite their differences in terms of the number of the banks. This finding invigorates the motivation and the scope of this paper, as it casts doubts on an a priori sample separation depending uniquely on banking segments. A thorough look into the two classes permits us to extract interesting inferences regarding the nature of the financial institution that belongs to each regime.

Regarding the UK banking sector, we highlight the fact that the vast majority of the building societies appears to be in the first regime. Similarly, savings banks appear almost unanimously in the first regime as well. These two aforementioned results trigger our hypothesis that both building societies and savings banks exhibit rather high efficiency levels compared to commercial types of banks. One might conjecture that the miscellaneous activities of a commercial bank may be the primar cause of financial turmoil like the one we experienced from August 2007 and accompanied inevitably by its calamitous consequences to the economic growth of both developed and emerging markets. If this assumption holds, we potentially provide preliminary evidence of favour to one of the most crucial points in recent debates regarding the separation between an investment and a commercial arm of activities of a bank[23]. To this end some action has already be taken place in the UK. Specifically, the Independent Commission on Banking (ICB) proposes to "ring fence" retail and small business commercial banking from investment banking in the United Kingdom[24].

Turning to the Greek banking sector we find a similar story to the one described for the UK. Savings type and one Cooperative type of bank (Pancreatan Coopetative) appear in the first technological regime; however both regimes are actually dominated by commercial type banks, as the Greek banking sector is in general. Nevertheless, the rest of the Cooperative banks (Panellinia bank) appear in the less efficient regime [25]. As far as ownership is concerned, we highlight that it has rather a lukewarm effect, since there is an equal distribution of state-owned and private-owned banks among the two regimes. Note that most of the banks from the whole sample whose operations have been terminated either because they were acquired or because they were involved in a merging activity, belong to the first technological group as well.

A common point to both countries is that the four largest banks (in terms of assets, deposits and loans) are classified as being in the first regime. These are, HSBC, RBS, Lloyds and Barclays in UK and the Ethniki, Eurobank, Alpha and Pireaus in Greece. This finding is of extreme importance for Greece, since the four aforementioned banking

[23] It should be noted that in the UK major job losses have been recorded in investment banking and other financial institutions trading short-term financial instruments against long-term securities and loans

[24] Nevertheless, the "ring-fencing" idea is not yet put in action as there are opposing ideas from other member countries of the European Commission such as Germany and France.

[25] Panellinia Bank was established in April 2001 by the Cooperative Banks and Credit Union in Greece in an effort to achieve economies of scale and due to commercial competition.

groups are designed to compose the four cornerstones of recovery of the Greek Economy. The European Financial Stability Fund (EFSF) in co-ordination with the Hellenic Financial Stability Fund (HFSF), decided to award the 'systemic' nature to these four banks and designed the recapitalization of them which can boost the economic activity of the country. Consequently, the classification of all four systemic banks into the most efficient technological regime has major policy implications regarding the success and the scope of the recent wave of banks' M&As and in general for the country's disengagement from the recession after five consecutive years.

2.5.6 Robustness checks

In order to examine the robustness of our findings we perform a series of robustness tests. First, as noted in section 3 we conduct exactly the same analysis but instead of following Orea and Kumbhakar's (2004) panel data methodology, we follow Bos et al. (2010) pooled cross-section strategy that allows the financial institution to be in one regime a specific year and in another regime the year after. Unequivocally, for both countries the results do not reveal any significant differences regarding the number of different technological regimes (i.e. two classes) and the classification of banks among these two regimes. Specifically, more than 80% of the yearly observations of each credit institution in both banking sectors are in the same class as they are when we use Orea and Kumbhakar's (2004) modelling strategy. With respect to the remaining 20%, where for some year-observations the credit institution seems to change class, we highlight that this transition occurs no more than two consecutive years and in the first year-observations for all the credit institutions that belong to this 20% in both countries. The only rudimentary difference apparent in the results in both countries, is that all the class membership determinants are statistically significant and larger than in the previous panel nature of the data sets. Consequently, we add to our previous findings that for both countries the credit institutions that belong to the first technological regime are the more profitable compared with their peers in the second regime. Specifically, in terms of the Greek banking sector it seems that the broader the variety of products the banks provide, the higher the probability for them to be classified in the first technological regime[26]. This larger statistical significance is apparent in the case of the kernel determinants as well. It must be noted that no change in terms of signs is found. In turn, we argue that all determinants' influence is in the same direction as before. Tables 2.10.a and 2.10.b display all the aforementioned findings for the UK and Greek banking sectors. Thus, we are confident regarding the correct number of identified distinct technological regimes, the appropriateness of our determinants to allocate the credit institutions in the two regimes and most importantly the exact classification of each credit institution to the two technological groups.

Next, we notice that the level of loans to loss provisions increases considerably after 2007 and 2008 for the UK and Greece respectively. Some concerns arise regarding the scenario that our results in terms of efficiency and allocation of banks to the two technological regimes may be biased as they may be driven by the global financial crisis. In order to exclude any element of the crisis and examine the heterogeneity of the two banking sectors in a tranquil period, we truncate our sample and re-estimate our model without the inclusion of the

[26] Nonetheless, it must be noted that despite the broader variety of products and services that Greek banks provide compared to the last decade, it is still small in size and sophistication comparing to the services being provided by 'Universal' type of banks, such as the large UK financial institutions.

period 2007-2011 for both countries. As far as the Greek banks are concerned we notice that in Table 2.11.b the classification remains almost unchanged[27]. Hence, we have strong evidence that our inferences regarding the Greek banking sector are extracted with precision. As far as the UK banks are concerned, we note in Table 2.11.a that 20% (10 banks) of the banks that belonged to the second (and less efficient) regime move to the first, whereas less than 5% of banks (3banks) move from the first to the second class[28]. In the same spirit with Greece, we can conclude that the financial crisis had a greater impact on the UK banking secto than in the case of Greece. Specifically, it had a severe impact on the technology of the UK financial institutions which allowed them to gain higher levels of cost efficiency. Consequently, their initial position has deteriorated and they have moved further away from the efficient frontier[29].

In order to be even more persistent in testing our implications regarding both the efficiency and the heterogeneity of the UK and Greek banks, we account for macroeconomic, financial, country-specific and bank-specific conditions as previous studies have noted (Pasiouras 2008). For this purpose, we account for additional factors which we

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[27] Only one bank namely 'Millenium' bank moves towards the most efficient class and another, 'Panellinia bank', exits our sample since after the year-filtering, was left only with one year-observation.

[28] As in the case of Greece for the same reason 7 banks do not appear in the classification up to 2006 in table 2.11.a. .

[29] The case of HBOS constitutes an example of a bank that moved to the less efficient regime during the years of the financial crisis.

HBOS was formed by the 2001 merger of Halifax plc. and the Bank of Scotland. The formation of HBOS was heralded as creating a fifth force in British banking and UK's largest mortgage lender. HBOS was acquired by Lloyds TSB in January 2009. In February 2009, Lloyds Banking Group revealed losses of £10bn at HBOS, £1.6bn higher than Lloyds had anticipated in November because of deterioration in the housing market and weakening company profits.

use both as inefficiency and class membership determinants. Regarding macroeconomic conditions, we take into consideration the level of real GDP growth. As far as financial traits are concerned, we account for the three month Treasury bill. Additionally we account for a bank-specific financial factor, such as the stock return both in time t and t-1[30]. Then, we consider specific dynamics regarding the nature of each banking sector. For this, we add in our analysis the Herfindahl Hirschman index (HHI) to capture the concentration of each banking system and to examine whether it has any impact on the efficiency and consequently on the technological heterogeneity among the banks. We note, that we calculate the HHI not only in terms of assets, but in terms of loans and deposits as well so as to be as much robust as we can. Additionally, as in the case of the financial factors, we examine the bank specific trait relating to the HHI. We account for the market power of each bank in the sample. Lastly, we consider the number of acquisitions that the bank has performed throughout the sample period, following a previous study that highlights the importance of its inclusion (Orea, Kumbhakar 2004)[31]. Unequivocally, for each country none of these determinants are found to be statistically significant which could support its inclusion. This finding, amplifies our selection of determinants regarding their suitability in capturing and revealing all the differences in terms of efficiency and technological heterogeneity of the entire UK and Greek banking sector.

Concentrating on the Greek banking sector we check the perfor-

[30] We note here that not all the banks in the sample are quoted. We have missing data, especially in the UK sample.

[31] In order to take into consideration each bank's acquisitions, we construct a dummy variable that takes a value of zero if the bank doesn't acquire any financial institution, and its value is increased by one every time the bank acquires another bank.

mance of the banks' stock returns during the years in our sample which are displayed in figure 2.2[32]. The results are in line with our previous findings regarding the systemic banks and their classification in the most efficient regime and consistent with previous empirical studies (Pasiouras et. al 2008). The stock returns of the four cornerstones in the new era of the Greek banking system outperformed the remaining four banks which all belong to the second technological class.

2.5.7 Mergers and Acquisitions: Recent & Prospective

As a next step, we try to shed light on the aspect of recent and potential mergers and acquisitions of UK and Greek banks. We endeavour to examine from an efficiency point of view whether the creation of the new bank will potentially move it to the most efficient technological regime and in turn, whether it can increase the scores of the total factor productivity of the industry resulting in a larger social welfare. At this point we highlight our twofold contribution: Firstly, we provide for the first time in the literature an econometric method to evaluate and compare the efficiency gains or losses of a potential M&A activity. The latter is of extreme importance for policy makers and practitioners, since after the onset of the global financial turmoil we have witnessed numerous cases of banks' M&A world-widely and there are daily speculations about new ones, regardless of whether those finan-

[32] Stock return movement for listed Greek banks in the Athens Stock Exchange (ASE) market were obtained from Datastream.

Some banks are not listed in the stock Market; nonetheless, their total market share is less than 3% of the total assets of Greek banking sector.

The absence of many large in terms of assets banks from the UK Stock exchange prevent us from conducting the same analysis for UK.

cial institutions are labelled, in terms of specialization, as commercial, saving, co-operative, real estate & mortgage bank etc. Secondly, we are able to extract unbiased inferences with major policy implications regarding the true origins of a M&A activity, in terms of promoting the social welfare or managerial purposes. To achieve the last two contribution points, we investigate all the possible combinations of mergers and acquisitions that could occur in the two banking sectors and we are motivated by the substantial changes that have been taking place since the summer of 2012 up to present in the Greek banking sector. In what follows, we present a brief retrospect of our motivation.

Prior to the crisis, the Greek banking sector was highly competitive by international standards, with sound fundamentals. But the sovereign crisis put the sector under stress as banks experienced substantial deposit outflows, became cut off from capital markets, and took sharp losses on Greek sovereign bonds. The banks responded by deleveraging, a process that itself contributed to economic contraction and created negative feedback loops between the financial and real sectors. Under these circumstances, the stability of the Greek banking system was at risk, with possible implications beyond Greece. Unequivocally, a leaner, restructured Greek banking sector was needed. In this environment, the Bank of Greece, in close cooperation with the troika, set out to create a viable and well-capitalized banking sector, recognizing that it would play a fundamental role in steering the future course of the economy. Their strategy aimed at strengthening viable institutions and wind down nonviable institutions while safeguarding financial stability. It included basically two fundamental points: i) a major consolidation of the banking sector and ii) a restructuring and a recapitalization of the 'new' Greek banking sector. Regarding the first point, the idea was that the expected market shares of the remaining banks will ensure a competitive environment while allowing banks to benefit from economies of scale. Intention of the second point was to create stronger, well-capitalized banks, new confidence for depositors and renewed access to capital markets so that finally Greek banks can return to their basic role of financing the Greek economy. This resulted in a series of M&As until the end of 2013 and finally the creation of four systemic banks who have been assigned the important role of sustaining and promoting the Greek economy and their recapitalisation process through the European Financial Stability Fund (E.F.S.F) and the Hellenic Financial Stability Fund (H.F.S.F). In Table 2.12 we provide detailed information regarding the four systemic banks and all this recent M&A activity as well as the remaining banks in the Greek banking sector.

At this point we try to test two hypotheses related with M&A activity and different technological regimes. Firstly, we investigate whether the recent wave of M&As that the Greek banking sector experienced, allocates the 'new' bank to either a higher or to a lower technological regime in terms of efficiency. Secondly we examine whether potential M&As in both the Greek and the UK banking system will be beneficial for the newly created bank in terms of efficiency. Before we continue with the analysis of the results we highlight a difference within the examination strategy of potential M&A of the two systems. For the UK banking sector, we select the nine most important banks in terms of assets, deposits and loans that belong to the most efficient technological regime (i.e. the first one) and the eleven most important from the second technologically and less efficient group after we ensure that each of these latter twenty banks is not a subsidiary of the remaining nineteen. Table 2.13 includes information on all the UK banks and their classification which we use in this analysis. Consequently, we create every potential combination of M&A among the nine and the eleven respective banks in each regime. In this way we are able to test whether the new bank would benefit from the M&A activity through a transition from the lesser to the more efficient class or would deteriorate its efficiency level through an exact opposite in terms of direction transition. Turning our attention to the Greek banking Sector we note that things are a bit more complicated due to the M&As that recently took place. Specifically, we select all the remaining banks that have not been involved in the recent wave of consolidation of the four systemic banks and we create all potential combinations of M&As either among themselves or with one of the four cornerstones of the Greek economy. Additionally we control for both single and multiple M&A by one banking institution. Last but not least, regarding the four systemic banks, we examine both their 'recent' and potential M&As in every possible combination (i.e., either one-by-one, two-by-two, etc. or by all the acquired banks together), in order to test what would be the bank's regime-classification if it had not been involved in the recent consolidation process and focus only in the potential cases of M&As. In tables 2.14.a and 2.14.b we present all the cases of potential and recent/potential M&A activity for the UK and Greece respectively and their classification in the two different technological regimes[33].

One of the most substantial finding as far as the Greek banking sector is concerned is that two out of the four newly designed engines to

[33] Regarding the 'recent' M&As cases that the Greek banking sector experienced, we approach each one of these cases as a potential scenario in the economy, since our sample is dated up to 2011 and the recent consolidation wave took place in 2012 and 2013.

Additionally, to construct the potential M&As combinations we exclude the banks whose operations have been terminated in the last year of our sample (i.e. 2011) and those who have terminated their operations after 2011 until present in order for the results to be of relative policy importance.

promote the Greek economic recovery, namely Eurobank and Piraeus, after their series of acquisitions, are found to be in the less efficient technologically class as opposed to the other two ones, Alpha bank and Ethniki bank, where despite their recent acquisitions, they still belong to the first technological regime. On the one hand it seems that if Eurobank had absorbed only TT-Hellenic Postbank, the new bank would have resulted in the first and higher efficiency regime, whereas the acquisition of just Proton bank (without TT-Hellenic Postbank) , would have deteriorated Eurobank's position before any M&A activity had occurred. On the other hand, it may be easier to comprehend Piraeus bank's case, since it is involved in the largest consolidation activity which may encumber its efficiency levels. In order to provide a more thorough explanation, we look at each-one of the Piraeus bank's acquisitions separately and gradually we add to it another financial institution from the list of banks that were absorbed in the end. Table 2.14.b demonstrates that only two banks, namely Marfin-Egnatia bank and Millenium bank after being acquired by Piraeus bank either individually or simultaneously, would have led to a newly created bank that would have been allocated to the most efficient technologically class. On the contrary we find evidence that every combination of banking institutions regarding a potential M&A activity of Pireaus bank with ATE bank and/or Geniki bank with or without the presence of Marfin_Egnatia bank and Millenium bank, finds the new bank in the second and less efficient regime[34]. The last points cast major doubts on the true origins of motivation from the point of view of the Greek government, the EFSF, the HFSF and the executive boards of the financial institutions that were involved in the recent wave of consol-

[34] We study every combination of potential M&As activity of Pireaus bank which can be consisted from two up to five banking institutions.

idation in Greece. To be more explicit, we cast doubts on the decision of the policy makers and involving banks in the selection process of which financial institution will be the acquirer and which the target is concerned, regarding the true social welfare benefit of the consolidation process. However, we confirm the concerns of the officials, regarding the cancelled attempt of consolidation among the two of the four big banks, namely Ethiki and Eurobank, since we find a potential M&A activity among them in the less efficient technological regime.

Turning our attention now to potential M&As between the four cornerstones of the new era of the Greek economy and four remaining banking institutions namely, Attica bank, Aegean bank, Panellinia bank and Pancretan co-operative bank[35], we get some insightful outcomes. We examine all potential combinations of consolidation between the last four banking institutions, which are equally split among the two technological regimes, with or without the four systemic banks and before and after their recent acquiring activity as well. It is noteworthy to see, that all potential M&As of each of the four remaining banks with each of the systemic banks before they got involved in the recent consolidation, would have resulted the new bank to be classified to the first technological regime. This would be even more important for Attica bank and Panellinia bank which would upgrade their efficiency levels since they both belong to the second class. Shedding light on all future possible combinations of M&As between the remaining four banks and the status-quo of the four systemic banks reveals that the two co-operative banks (Pancretan and Panellinia) and Aegean bank create combinations of M&As where most of the times the new bank is found

[35] Attica bank and Aegean bank are commercial banking institutions, whereas Panellinia bank and Pancretan co-operative bank deal with co-operative banking activities.

to be classified in the first technological regime. The first systemic bank, Alpha bank, in the aftermath of Emporiki's acquisition, seems to create four out of fourteen of its overall potential combinations of M&As that are found to exhibit high efficiency levels, i.e. belong in the first technological class. These four prospective scenarios are constituted by the two co-operative banks and in two cases of the Aegean bank as well (see Table 2.14.b – *Potential M&As*). We find a similar picture regarding Ethniki bank (and FFB bank and Probank as well) and its potential combinations of consolidation with the non-systemic banks. The estimation results show that in 30% of the overall cases the new bank will be allocated in the first and most efficient technological class and thus enhance its level of cost efficiency due to the prospective consolidation activity. All the cases include Pancreatan bank. Nevertheless, there is a high frequency of appearance of both Attica bank and Panellinia bank which is of extreme importance, since those two financial institutions are found initially in the lower technologically efficient class. On the contrary, approximately only 7% of the potential combinations of the current structure of Eurobank (accompanied with New Proton bank and New TT-Hellenic Postbank) with the four non-systemic banks, creates a new bank which will have higher levels of efficiency. This will consist of a potential M&A activity between the new 'systemic' Eurobank and Pancretan bank. The remaining systemic bank, Pireaus bank (with ATE bank, Geniki bank, Marfin-Egnatia bank and Millenium bank as well), creates just twice more the Eurobank's M&As cases that result in the first technological regime (i.e which have enhanced efficiency levels). This consists of potential combinations of M&As among the new 'systemic' Piraeus bank either with Attica bank or with Attica bank and one of Aegean bank or Pancretan-Cooperative bank. All these results strengthen our initial and main finding, regarding, that two out of the four systemic banks we find to be classified in the highest in terms of efficiency technological class, are the ones that create potential combinations of consolidation whose efficiency is enhanced after the potential M&A activity. As a last exercise, we examine the non-systemic banks and their potential interactions. By the empirical evidence that we provide we can infer that 30% of the overall potential combinations of those four banking institutions is classified in the first technological regime. All the successful (i.e enhanced efficiency after the consolidation process) combinations consist of either Aegean bank or Pancretan bank with either Attica bank or with the joined combination of both Attica bank and Panellinia bank together. This outcome is of great interest since both Attica bank and Panellinia bank belong to the second technological regime and thus by the empirical evidence it seems that both can achieve higher efficiency levels after a potential consolidation activity either with Aegean bank or Pancretan bank. In turn, our results indicate that there are still considerable economies of scale for the smaller financial institutions in Greece that need to be exploited and there are additional efficiency gains and benefits of synergies that could be derived from the correct consolidation actions which will enable economic prosperity and growth.

Next, we focus our analysis on the UK banking sector and its potential consolidation wave. Table 2.14.a demonstrates the results about all potential M&As activity regarding the twenty (nine in the first technological regime and eleven in the second) most important players in terms of assets, loans and deposits at the end of our sample period. Since for each potential M&A case among the nine financial institutions that belong ex-ante to the first class, we find the 'new' bank to be classified in the same technological regime, for abbreviation purposes we do not report them in table 2.14.a. We display every potential combination of M&As among not just the twenty financial institutions in general, but, among the eleven banks that are found ex-ante in the second regime as well, in order to examine whether a specific consolidation movement can have as a result the transition of the 'new' bank in the more efficient regime (i.e the first one).

As far as the category of potential M&As among the banks that belong in the two different regimes is concerned, we notice from table 2.14.a that in approximately 40% of the cases the 'new' financial institution will be allocated in the first and most efficient technological regime. It is noteworthy that 20% of these potential M&A case, are constituted by a building society, namely Nationwide, and not a bank. Additionally, our results indicate that two of the big four of the UK banking sector, namely Barclays and HSBC, account for more than a quarter of the potential M&As cases which result in enhanced efficiency, whereas the remaining two large UK banks (RBS, Lloyds) account approximately for just a 13% of potential M&As that create a financial institution with higher efficiency level than before. This might reflect the calamitous impact of the financial crisis on the latter pair of banks which resulted in the ample financial assistance by the UK government with the aim of avoiding collapse of both banks[36]. Regarding the banks that belonged to the second group before they were involved in M&A activity we notice that in 75% of the cases, three banks and one building society, namely Alpha Bank, Bank of Beirut, Bank Leumi and Progressive Building Society, are found to create a financial institution that belongs to the most efficient class following their consolidation with their peers from the first technological regimes. We now examine the

[36] In 2008 and 2009, the UK government bailed out RBS and Lloyds. As a result both of them were partially nationalized.

potential combinations of consolidation among the financial institutions that belong only in the second technological regime. Contrary to the previous picture, from table 2.14.a, we infer that approximately in only 25% of the overall cases we find the new bank to be classified in the first regime. What is interesting is that these four banks account even in this specific analysis for two-thirds of the situations where we experience a transition towards a more efficient technological regime. Lastly our results show that Sainsbury's, the largest financial institution from those that belong to the second regime, would experience a transition to the first and more efficient technological class if it merged with one of either the 'big-four' of the UK banking system, or Sandander, Standard Chartered and Citibank.

On the whole among the two banking sectors, we notice some important similarities and differences. To begin with, before the recent wave of consolidation in Greece, both countries' big four banks belonged to the first technological regime. Whereas we find that this is *status quo* only for UK , in Greece two of its financial and economic cornerstones moved to the second technological regime as a consequence of their specific acquisition strategies. It is worth mentioning that in both countries, particularly for the smaller banks, there are significant economies of scale that need to be exploited, even though this is more apparent in the Greek banking system. Furthermore, there is a moderate potential of increased efficiency in both countries that can be achieved by a series of specific M&A between financial institutions that are allocated to the second technological regime. This, can have a crucial positive impact on the social well-being, by increasing liquidity and consequenlty increasing investment opportunities with an ultimate impact the promotion of growth.

2.6 Concluding remarks

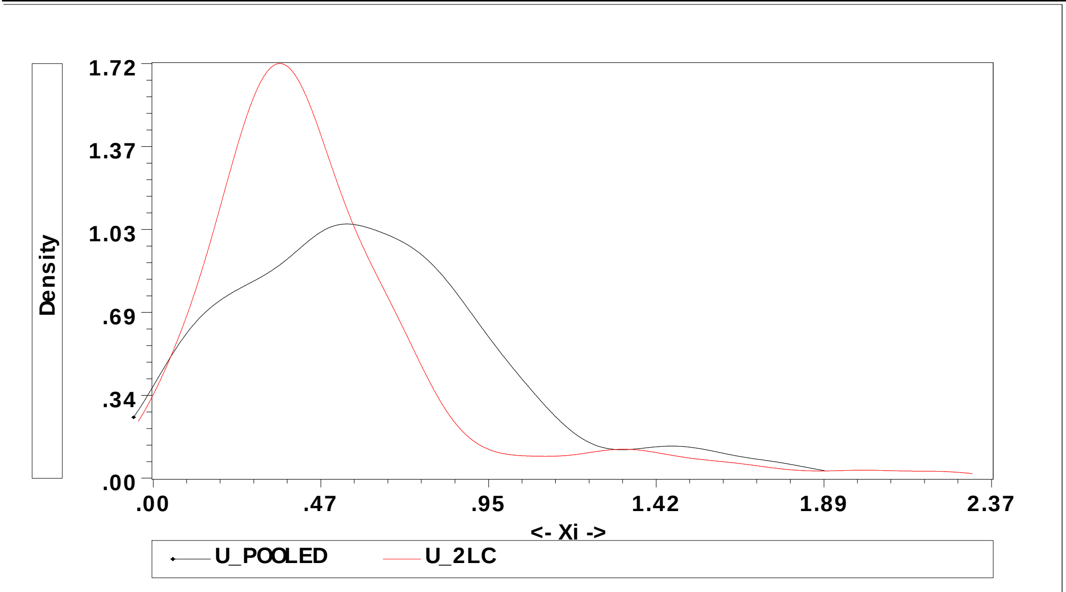
In this paper, for the first time evidence is provided on the existence of heterogeneous technological regimes in two absolutely different banking systems in terms of "sophistication, market characteristics and volume of transactions", that of the UK and Greece. Contrary to previous cross-country studies in the framework of a latent class stochastic frontier model that derive their country-specific inferences by assuming a common sample for all different countries and thus neglecting substantial differences that exist among them, we attempt to compare the countries of interest by examining them separately. Furthermore, we employ two different modelling strategies to test the sensitivity and the robustness of our results. To the best of our knowledge from all previous efficiency related banking studies, not only is the period we investigate the largest, but we allow for different financial institutions in terms of their "activities" as well. The former allows us to capture all the important developments of both banking sectors while the latter enables us to examine thoroughly the entire banking system of each country.

The results suggest that bank-heterogeneity in both countries is fully controlled by two different technological classes. More precisely, the first regime in each banking system consists of the most efficient credit institutions. We find, strong empirical evidence of a trade-off with regard to efficiency and the level of sophistication of a banking system. The findings hold across both different modelling strategies that we follow and after various robustness tests that we perform. Furthermore, we address with a circumspect manner and from a social well-being point of view the decisions of policymakers with regard to the selection of specific acquirers and targets during a recent wave of consolidation that took place in the Greek banking sector. Finally we provide detailed empirical evidence of enhanced efficiency in both countries as result of potential M&As.

Given the important role that the banking sector plays in the financial development of the UK and Greece and in several more developed and emerging economies, further research needs to be conducted in order to analyse the implications of technology differences among banks in the spectrum of potential M&A which could lead to the enhancement of growth and economic prosperity. This methodology could be applied to more countries with high level of public debt, a special situation that gives a higher weight of importance to the prime role of the banking sector in ensuring the financial stability of the country. All in all, attention should be given to different bank specific characteristics such as managerial behaviour and corporate governance, which are not accountable in financial bank statements but still have a great impact on the harmonic operation of financial institution. Such considerations could lead to more thorough inferences.

2.7 Appendix

Figure 2.1.a: UK - Kernel density of the estimated variance of the inefficient component

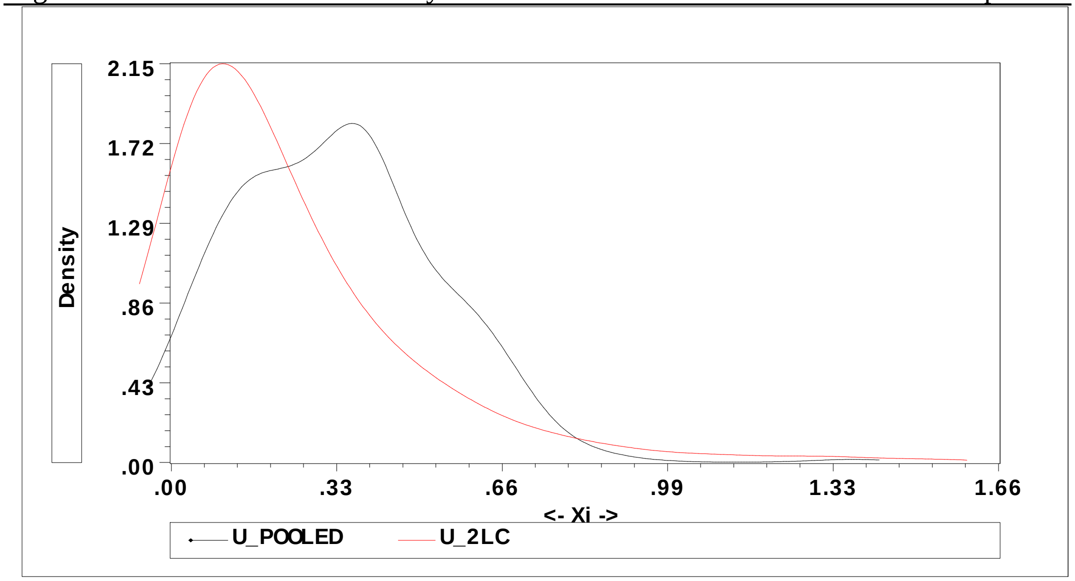


Notes: This figure displays the kernel density estimators for the two sets of the variance of inefficiencies {σ²u|k} as far as the UK banking sector is concerned . The model is

lnC(it)=lnC(y[it],w[it],t ;β[k])+u[it|k]+v[it|k]

where subscripts i=1,....N, t=1,....,T_{i} and k=1,...,K, stand for bank, time and class respectively. C{it} is individual bank total cost; y{it} and w{it} indicate vectors of output and input prices; β{k} is a class-specific vector of parameters to be estimated.The two-sided random error term v[it|k] is assumed to be independent of the non-negative cost efficiency variable u[it|k] for each class. Here the technology is represented by a dual cost function. U_POOLED' and 'U_2LC' refer to a model that assumes the same (k=1) production technology for all the banks in the sample and to a model with two (k=2) latent classes respectively.

Figure 2.1.b: Greece - Kernel density of the estimated variance of the inefficient component

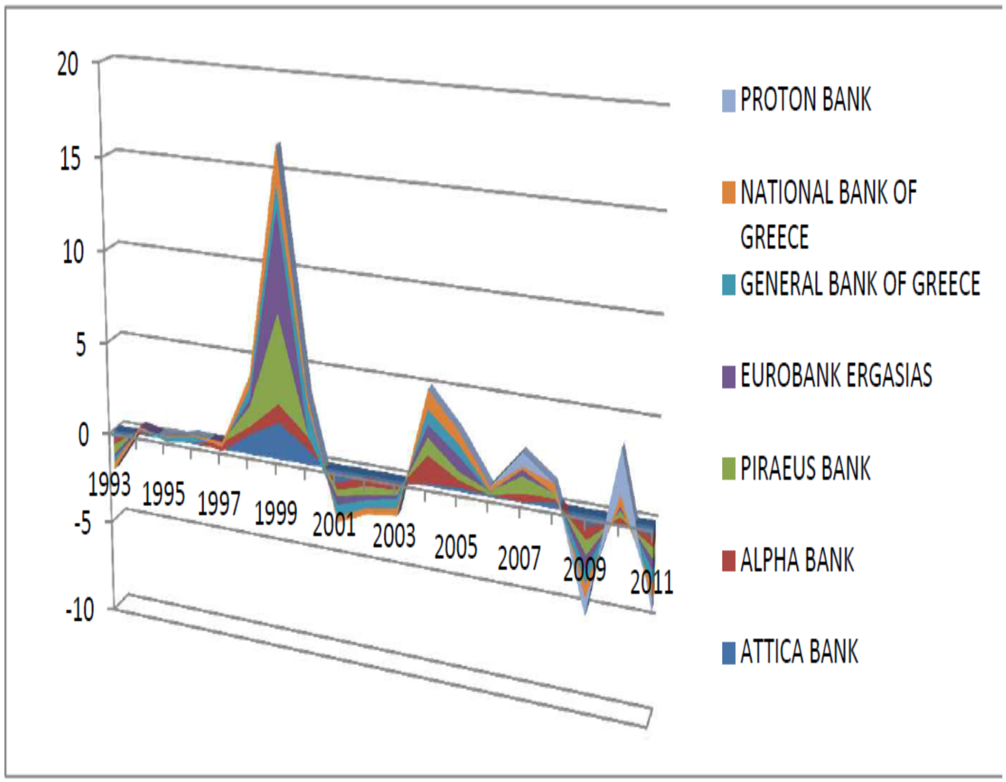


Notes: This figure displays the kernel density estimators for the two sets of the variance of inefficiencies {σ²u|k} as far as the Greek banking sector is concerned . The model is

$$lnC(it)=lnC(y[it],w[it],t\ ;\beta[k])+u[it|k]+v[it|k]$$

where subscripts i=1,....N, t=1,....,T_{i} and k=1,...,K, stand for bank, time and class respectively. C{it} is individual bank total cost; y{it} and w{it} indicate vectors of output and input prices; β{k} is a class-specific vector of parameters to be estimated.The two-sided random error term v[it|k] is assumed to be independent of the non-negative cost efficiency variable u[it|k] for each class. Here the technology is represented by a dual cost function. U_POOLED' and 'U_2LC' refer to a model that assumes the same (k=1) production technology for all the banks in the sample and to a model with two (k=2) latent classes respectively.

Figure 2.2: Greece - Stock returns of the 'quoted' Financial Intermediaries



Notes: This figure illustrates the movement of the Greek banks' stock returns that are listed in the Athens Stock Market for the period 1993 - 2011.

Table 2.1.a: UK - Time Series Analysis of characteristic banking indicators

year	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	HHI
1988	13	10.73	18.09	9.58	0.55	25.77	0.19
1989	40	16.6	26.98	14.33	0.86	338.95	0.12
1990	49	19.4	36.34	16.76	0.96	205.41	0.08
1991	53	21.63	37.9	18.64	1.11	287.72	0.08
1992	66	17.16	25.94	14.39	0.87	227.15	0.08
1993	69	15.95	23.62	13.04	0.81	147.54	0.07
1994	70	19.92	31.13	15.9	1.01	76.32	0.08
1995	80	14.56	22.57	11.56	0.89	45.88	0.06
1996	110	14.76	25.06	11.75	0.92	30.11	0.05
1997	114	18.04	29.84	14.22	0.99	38.9	0.08
1998	115	20.52	34.13	16.16	1.16	100.34	0.06
1999	116	18.3	29.59	14.47	1.2	73.44	0.05
2000	117	24.06	35.9	18.94	1.7	67.05	0.07
2001	120	23.65	34.3	18.73	1.77	95.16	0.06
2002	125	33.11	53.37	26.58	2.05	127.42	0.07
2003	127	35.3	63.01	27.02	2.76	137.02	0.06
2004	127	73.56	142.07	59.93	5.16	351.77	0.15
2005	126	87.6	150.83	62.92	4.42	223.69	0.12
2006	121	104.11	204.36	68.12	6.32	541.66	0.14
2007	120	132.24	264.95	98.8	8.22	579.07	0.23
2008	116	107.92	157.32	53.52	4.1	783.78	0.09
2009	116	87.82	142.22	53.25	7.16	971.87	0.08
2010	113	86.56	135.5	51.52	7.32	675.16	0.07
2011	101	138.39	213.96	80.69	10.43	863.94	0.08
Total	2324	1141.89	1938.98	790.82	72.74	7015.12	0.09

Notes: This table presents an overview of the UK banking system throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, HHI represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Concentration (expressed by the Herfindahl-Hirschman (HHI) Index and it is defined as the sum of the squares of the market shares of all banks in the sample for each year: a HHI index below 0.01 indicates a highly competitive index, a HHI index below 0.15 indicates an unconcentrated index, a HHI index between 0.15 to 0.25 indicates moderate concentration, while a HHI index above 0.25 indicates high concentration.) respectively. 'B' stands for billions while 'M' for millions.

Table 2.1.b: Greece - Time Series Analysis of characteristic banking indicators

year	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	HHI
1993	19	3.84	5.24	3.28	0.17	12.91	0.21
1994	19	4.85	6.89	4.18	0.22	18.54	0.23
1995	19	6.05	8.7	5.25	0.26	13.78	0.21
1996	21	5.04	6.95	4.49	0.24	24.62	0.16
1997	21	5.74	6.92	5.07	0.27	32.97	0.2
1998	20	6.79	8.19	6.06	0.42	41.5	0.16
1999	16	8.77	9.1	7.47	0.9	45.36	0.16
2000	15	9.31	8.77	8.04	0.83	38.31	0.16
2001	15	9.94	8.76	8.77	0.76	44.99	0.17
2002	18	9.85	10.33	8.76	0.6	47.85	0.18
2003	20	11.84	14.96	10.17	0.81	75.79	0.16
2004	21	13.33	18.15	10.83	0.79	89.34	0.15
2005	21	13.44	15.86	10.93	0.93	75.35	0.14
2006	19	19.2	25.29	15.08	1.39	125.15	0.14
2007	19	26.95	39.68	19.55	2.27	120.8	0.13
2008	19	31.71	44.12	25.05	2.13	260.27	0.14
2009	19	34.67	49.95	28.1	2.85	424.91	0.14
2010	20	30.36	40.57	24.77	2.74	562.62	0.13
2011	15	30.54	39.51	26.21	1.1	1779.96	0.19
Total	356	282.22	367.94	232.06	19.68	3835.02	0.17

Notes: This table presents an overview of the Greek banking system throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, HHI represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Concentration (expressed by the Herfindahl-Hirschman (HHI) Index and it is defined as the sum of the squares of the market shares of all banks in the sample for each year: a HHI index below 0.01 indicates a highly competitive index, a HHI index below 0.15 indicates an unconcentrated index, a HHI index between 0.15 to 0.25 indicates moderate concentration, while a HHI index above 0.25 indicates high concentration.) respectively. 'B' stands for billions while 'M' for millions.

Table 2.2.a: UK - Financial Intermediaries Analysis of characteristic banking indicators

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
ABC Int.	1996-2011	16	3.19	1.38	2.33	0.41	5.72	0.35
AIB Bank	1992-2008	17	2.23	0.14	2.05	0.14	0	0.25
AIB Group	1995-2011	17	25.81	16.41	22.26	1.36	219.22	2.86
Abbey Nat.	1990-2011	22	190.34	27.9	126.34	3.65	45.36	21.09
Adam & Company	1989-2011	23	1.63	0.59	1.52	0.08	1.47	0.18
Ahli United	1989-2011	23	2.78	1.29	2.32	0.21	10.63	0.31
Alliance & Leic. BS	1988-1996	9	29.95	23.6	26.42	1.49	106.78	3.32
Alliance & Leic. Bank	1995-2006	12	5.44	1.65	4.32	0.45	6.17	0.6
Alliance & Leic. Plc	1996-2011	16	80.46	57.6	59.22	2.64	182.14	8.92
Alpha Bank	1989-2011	23	0.59	0.29	0.5	0.08	1.49	0.07
Anglo-Romanian	1989-2010	22	0.25	0.11	0.17	0.06	2.26	0.03
Arbuthnot	1991-2011	21	0.27	0.14	0.21	0.04	1.55	0.03
BMCE Int.	2006-2011	6	0.36	0.17	0.28	0.06	0.55	0.04
Bank Leumi	1996-2011	16	1.72	1.17	1.5	0.15	7.13	0.19
Bank Mandiri	1999-2011	13	0.17	0.08	0.11	0.05	3.42	0.02
Bank Saderat	1996-2011	16	0.82	0.18	0.55	0.19	0.61	0.09
Bank of Beirut	2002-2011	10	0.35	0.14	0.27	0.06	0.08	0.04
Bank of China	2007-2011	5	1.18	0.6	1.01	0.24	7.36	0.13
Bank of Cyprus	1997-2003	7	0.85	0.55	0.75	0.07	0.43	0.09
Bank of N.Y. Mellon	1997-2011	15	5.11	0.22	4.47	0.33	0	0.57
Bank of Scotland	1990-2011	22	368.13	256.88	260.55	12.28	3821.53	40.79
Bank of Tokyo	1988-1996	9	0.68	0.28	0.59	0.06	5.91	0.08
Bank of Philip. Isl.	2009-2011	3	35.73	0.49	3.45	32.01	18	3.96
Barclays Bank	1992-2011	20	1262.61	431.68	647.54	42.14	3266.07	139.91
Barclays Priv. & Tr.	2002-2005	4	2.07	0.18	1.79	0.24	0.47	0.23
Barclays Priv. Clien.	2002-2008	7	27.88	4.01	26.22	1.06	10.92	3.09
Barnsley BS	1992-2007	16	0.45	0.34	0.41	0.03	0.27	0.05
Bath BS Sav. & Inv.	1995-2010	16	0.26	0.19	0.24	0.02	0.09	0.03
Beneficial Bank	1988-1998	11	2.2	1.95	1.31	0.23	98.35	0.24
Beverley BS	1996-2011	16	0.17	0.13	0.16	0.01	0.18	0.02
Birmingham Mid. BS	1988-1998	11	8.43	6.96	7.63	0.4	16.74	0.93
Bradford & Bingley BS	1988-1999	12	23.59	18.76	21.38	1.26	24.3	2.61
Bradford & Bingley Int.	2007-2010	4	3.91	3.74	3.53	0.37	0	0.43
Bradford & Bingley Bank	1999-2011	13	68.99	54.42	35.75	2.18	181.36	7.65
Bristol & West BS	1988-1996	9	10.93	8.83	9.81	0.54	39.43	1.21
Britannia BS	1989-2009	21	35.06	22.06	27.75	1.64	19.22	3.89
British Arab	1989-2011	23	2.68	0.62	2.3	0.21	5.32	0.3
Buckinghamshire BS	2003-2011	9	0.25	0.18	0.23	0.02	0.02	0.03
Butterfield Guernsey	1996-2011	16	1.12	0.22	1.02	0.07	0.62	0.12
Butterfield Holdings	1992-2010	19	0.5	0.11	0.44	0.05	-0.01	0.06
Cambridge BS	1996-2011	16	1.24	0.91	1.15	0.08	0.49	0.14
Capital One	2002-2011	10	6.96	6.07	2.64	0.65	382.69	0.77
Catholic BS	1997-2007	11	0.06	0.04	0.06	0	0	0.01
Chelsea BS	1990-2009	20	12.72	9.61	11.08	0.55	12.7	1.41
Cheltenham & Gloucester BS	1988-1995	8	22.82	19.26	20.98	1.08	79.71	2.53
Cheltenham & Gloucester Bank	1996-2011	16	66.45	94.73	88.26	2.41	-6.19	7.36
Cheshire BS	1990-2007	18	5.2	4.02	4.07	0.25	4.04	0.58
Citibank	1989-2011	23	31.44	9.95	24.01	2.69	234.57	3.48
City of Derry BS	1998-2010	13	0.04	0.03	0.04	0	0.16	0
Co-operative	1990-2011	22	17.88	11.85	15.27	0.93	112.16	1.98
Consolidated Credits	2002-2011	10	0.15	0	0.12	0.03	0	0.02
Coventry BS	1989-2011	23	18.11	12.92	15.16	0.71	8.33	2.01
Credit Agricole	2000-2004	5	2.6	0.47	1.45	0.07	0	0.29
Credit Suisse	1997-2011	15	1.75	0.44	1.59	0.09	0	0.19
Cuscatlan Bank and Trust	2002-2006	5	0.33	0.19	0.28	0.04	0.38	0.04

(Continued)

Table 2.2.a: UK - Financial Intermediaries Analysis of characteristic banking indicators (Continued)

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
DB UK	1996-2011	16	14.44	3	7.57	1.31	1.39	1.6
Darlington BS	1996-2011	16	0.87	0.67	0.8	0.06	0.52	0.1
Derbyshire BS	1992-2007	16	6.4	5.02	5.85	0.34	0.92	0.71
Dexia Municipal	1992-1999	8	0.61	0.52	0.53	0.05	0.28	0.07
Dunbar	1995-2010	16	1.12	0.99	0.85	0.21	70.78	0.12
Duncan Lawrie	2008-2010	3	0.24	0.06	0.2	0.04	0	0.03
Dunfermline BS	1992-2007	16	3.26	2.52	2.99	0.17	0.84	0.36
Ecology BS	1997-2011	15	0.1	0.07	0.09	0.01	0.09	0.01
Egg	1996-2011	16	11.89	7.14	9.81	0.58	258.35	1.32
Europe Arab	2005-2011	7	5.61	2.51	5.38	0.42	47.33	0.62
FBN	2003-2011	9	1.49	0.34	1.25	0.11	-1.35	0.17
FIBI	1996-2011	16	0.35	0.25	0.27	0.07	0.63	0.04
Fairbairn	1998-2011	14	1.01	0.26	0.94	0.06	0.3	0.11
Finsbury Pavement	1991-2006	16	0.8	0.16	0.58	0.17	0.17	0.09
Furness BS	1996-2011	16	1.2	0.93	1.1	0.07	0.36	0.13
Gainsborough BS	1992-2000	9	0.05	0.03	0.04	0	0	0.01
Ghana	1998-2011	14	0.51	0.05	0.43	0.07	0.16	0.06
Gresham Trust	1993-2000	8	0.15	0	0.02	0.13	0	0.02
HBOS	2000-2011	12	494.11	387.03	383.7	26.91	7010.74	54.75
HFC	1989-2011	23	4.29	3.25	2.35	0.46	230.8	0.48
HSBC Middle East	1989-2011	23	12.93	7.17	10.38	1.04	144.53	1.43
HSBC	1989-2011	23	488.09	200.1	279.61	22.28	1175.48	54.09
Habib Allied	2001-2011	11	122.81	40.29	103.93	11.85	246.18	13.61
Habibsons	1996-2011	16	0.32	0.08	0.29	0.02	0.41	0.04
Halifax	1996-2006	11	301.63	220.16	264.75	10.49	526.95	33.43
Harpenden BS	1996-2011	16	0.21	0.16	0.19	0.01	0.09	0.02
Heritable	1989-2007	19	0.46	0.41	0.38	0.05	1.3	0.05
ICBC	2003-2011	9	0.91	0.35	0.72	0.16	-0.16	0.1
Ilkeston Permanent BS	1997-2000	4	0.03	0.02	0.02	0	0	0
Isle of Man Bank Limited	1995-2011	17	5.09	1.11	4.64	0.36	0.27	0.56
Italian Int.	1988-1997	10	2.37	0.35	2.14	0.12	1.16	0.26
JP Morgan	1996-2011	16	1.95	1.5	0.14	0.98	0	0.22
Jordan Int.	1996-2011	16	0.33	0.07	0.28	0.04	6.69	0.04
KDB Bank	1992-1998	7	0.38	0.08	0.31	0.05	5	0.04
Kaupthing Singer & Friedlander	1989-2007	19	1968.65	1233.45	1638.98	144.34	7931.22	218.15
Kingdom	2009-2011	3	0.08	0.05	0.07	0.01	0.4	0.01
Kookmin	1995-2010	16	0.26	0.03	0.21	0.04	1.46	0.03
Lazard & Co Holdings	1999-2011	13	1.1	0.31	0.81	0.21	0	0.12
Leeds BS	1989-2011	23	9.75	7.63	8.28	0.53	23.14	1.08
Leek United BS	1996-2011	16	1.1	0.86	1.01	0.07	0.15	0.12
Lloyds (BLSA)	1992-2001	10	1.96	0.72	1.7	0.12	13.81	0.22
Lloyds	1988-1998	11	132.06	78.23	109.79	5.85	999.95	14.63
Lloyds TSB	1998-2011	14	539.94	309.35	373.09	25.28	3962.68	59.83
Lloyds TSB Scotland	1989-2010	22	11.54	8.41	10.4	0.73	43.28	1.28
London Int.	2001-2006	6	0.01	0	0	0.01	0	0
London Trust	1991-1998	8	0.06	0.03	0.04	0.01	0.7	0.01
MBNA Europe Bank	1995-2010	16	11.94	9.83	6.49	1.82	607.25	1.32
Manchester BS	1990-2011	22	0.83	0.64	0.75	0.05	0.99	0.09
Mansfield Building Society	1995-2011	16	0.32	0.25	0.29	0.03	0.05	0.04
Market Harborough BS	1998-2011	14	0.64	0.5	0.59	0.04	0.03	0.07
Marsden BS	1996-2011	16	0.53	0.38	0.48	0.04	0.59	0.06
Melli	2001-2011	11	1.54	0.19	1.14	0.27	4.49	0.17
Melton Mowbray BS	1996-2011	16	0.6	0.43	0.54	0.05	0.2	0.07
Mercantile BS	1992-2005	14	0.29	0.22	0.26	0.02	0.04	0.03
Merrill Lynch	1990-2005	16	11.59	5.81	8.24	0.8	3.28	1.28

(Continued)

Table 2.2.a: UK - Financial Intermediaries Analysis of characteristic banking indicators (Continued)

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
Morgan Stanley	2001-2011	11	7.61	2.14	4.1	1.02	17.26	0.84
National Bank of Kuwait	1996-2011	16	1.88	0.65	1.55	0.28	0.66	0.21
National Counties BS	1996-2011	16	1.57	1.15	1.11	0.44	1.28	0.17
National Westminster	1989-2011	23	294.59	167.49	240.32	14.12	2146.48	32.65
Nationwide BS	1990-2011	22	175.11	135.5	145.05	6.57	241.61	19.41
Newcastle BS	1989-2011	23	5.16	4.02	4.48	0.27	3.85	0.57
Northern	1995-2010	16	7.54	5.71	6.24	0.48	42.29	0.84
Northern Rock	1996-2011	16	89.7	72.91	51.35	2.29	370.68	9.94
Northern Rock BS	1987-1996	10	10.41	8.61	9.56	0.48	14.03	1.15
Norwich & Peterborough BS	1995-2010	16	5.52	4.17	5.07	0.27	4.93	0.61
Nottingham BS	1992-2011	20	3.07	2.48	2.82	0.18	0.92	0.34
PNB	1997-2011	15	0.03	0	0.02	0.01	0.11	0
Penrith BuS	2008-2011	4	0.14	0.09	0.12	0.02	0	0.02
Portman BS	1989-2006	18	15.72	11.46	13.84	0.77	7.4	1.74
Principality BS	1989-2011	23	6.22	4.72	5.48	0.34	9.59	0.69
Progressive BS	1996-2011	16	1.84	1.46	1.71	0.09	1.46	0.2
Prudential-Bache	1996-2001	6	0.58	0.21	0.48	0.08	0	0.06
Riggs	1989-2004	16	0.41	0.24	0.34	0.05	4.45	0.05
Riyad	1993-1997	5	0.16	0.02	0.12	0.05	0.1	0.02
Royal Bank of Scotland Int.	1996-2008	13	29.11	5.41	26.63	2.08	35.04	3.23
Royal Bank of Scotland	1995-2011	17	930.46	401.98	482.44	42.5	4124.73	103.11
Saffron BS	1996-2011	16	1.09	0.77	1.01	0.06	0.36	0.12
Sainsbury's	2002-2011	10	6.86	3.65	6.2	0.31	104.87	0.76
Santander	1989-2011	23	243.49	150.01	177.69	8.59	461.62	26.98
Schroders	1989-2011	23	8.2	1.03	3.9	1.6	5.18	0.91
Secure Trust	1999-2011	13	0.13	0.08	0.11	0.01	1.11	0.01
Shepshed BS	1997-2011	15	0.12	0.08	0.11	0.01	0.08	0.01
Skipton BS	1989-2011	23	13.26	9.2	11.44	0.71	16.35	1.47
Staffordshire BS	1989-2002	14	1.82	1.5	1.64	0.13	1.7	0.2
Standard	2000-2011	12	21.72	5.95	12.61	1.01	31.88	2.41
Standard Chartered	1998-2011	14	240.37	102.85	145.94	16.09	677.87	26.64
Standard Chartered Plc	1990-2011	22	122.96	72.43	124.62	11.31	601.8	13.63
Stroud & Swindon BS	1994-2009	16	3.64	2.61	3.38	0.14	0.45	0.4
Swansea BS	1996-2011	16	0.16	0.11	0.14	0.01	0.07	0.02
TSB	1988-1997	10	41.56	27.36	35.78	2.69	276.84	4.61
Teachers' BS	1996-2011	16	0.36	0.28	0.25	0.11	-0.01	0.04
The Access	2008-2011	4	0.3	0.03	0.26	0.04	0	0.03
Tipton & Coseley BS	2001-2011	11	0.5	0.39	0.46	0.03	0.41	0.06
Turkish	1996-2011	16	0.18	0.06	0.16	0.03	0.04	0.02
Ulster	1989-2011	23	29.02	21.05	21.82	2.3	812.56	3.22
Union	2005-2011	7	0.94	0.04	0.87	0.05	-0.08	0.1
United National	2001-2011	11	0.23	0.09	0.16	0.06	0.15	0.03
United Trust	1999-2011	13	0.13	0.09	0.1	0.02	1.44	0.01
Unity Trust	1991-2011	21	0.54	0.12	0.49	0.04	1.08	0.06
Universal BS	1992-2005	14	0.6	0.48	0.54	0.03	0.31	0.07
VTB Capital	2004-2011	8	4.91	1.53	1.67	0.65	15.32	0.54
Vernon BS	1993-2011	13	51.9	39.3	48.13	3.51	9.98	5.75
Weatherbys	1997-2011	15	0.23	0.07	0.2	0.02	0.83	0.03
Wesleyan	2001-2011	11	0.16	0.05	0.15	0.02	0.98	0.02
West Merchant	1988-1997	10	4.39	0.78	3.79	0.13	7.81	0.49
Woolwich BS	1988-1996	9	34.41	28.12	31.44	1.81	83.53	3.81
Yorkshire BS	1989-2011	23	25.51	16.76	21.5	1.17	12.8	2.83
Total		2327	9024.17	4977.99	6409.96	500.22	42418.32	100

Notes: This table presents an overview of all the UK financial intermediaries throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, Mar. Pr represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Power (measured as each bank's share of the indrustry's total assets) respectively. 'B' stands for billions while 'M' for millions.

Table 2.2.b: Greece- Financial Intermediaries Analysis of characteristic banking indicators

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
Aegean Baltic	2003-2011	9	0.3	0.17	0.23	0.07	1.59	0.1
Agricultural (ATE)	1993-2011	19	22.86	16.02	20.41	1.16	154.05	7.8
Alpha	1993-2011	19	37.62	24.22	28.64	2.42	422.81	12.9
Attica	1993-2011	19	2.9	2.16	2.54	0.25	33.54	1
Bank of Athens	1993-1997	5	0.36	0.18	0.32	0.03	2.15	0.1
Bank of Central Greece	1993-1998	6	0.51	0.24	0.44	0.05	2.84	0.2
Bank of Crete (Cretabank)	1993-1998	6	1.24	0.62	1.13	0.07	6.38	0.4
Emporiki (Commercial)	1993-2011	19	21.58	14.61	17.91	1.19	313.21	7.4
Ergobank	1993-1999	7	4.21	1.6	3.53	0.34	18.21	1.4
Eurobank Ergasias	1993-2011	19	42.12	26.19	33.16	2.66	753.08	14.4
FBB First Business	2002-2011	10	1.76	1.39	1.59	0.15	27.33	0.6
General	1993-2011	19	3.5	2.71	3.13	0.19	103.4	1.2
Ionian and Popular	1993-1998	6	5.53	1.75	4.79	0.26	39.29	1.9
Laiki	1993-2005	13	1.62	1.04	1.47	0.12	16.96	0.6
Macedonia Thrace	1993-1999	7	1.53	0.62	1.32	0.14	12.58	0.5
Marfin	1993-2005	13	0.48	0.2	0.43	0.04	4.28	0.2
Marfin Egnatia	1993-2010	18	8.58	5.59	7.34	0.5	70.25	2.9
Millennium	2000-2011	12	5.7	4.24	4.7	0.33	31.51	1.9
National Bank of Greece (Ethiki)	1993-2011	19	68.15	35.19	58.65	4.02	465.16	23.3
National Mortgage Bank	1993-1997	5	7.09	3.53	5.63	0.22	8.3	2.4
Omega	2001-2004	4	0.76	0.45	0.67	0.08	2.7	0.3
PRObank	2001-2011	11	3.42	2.42	3.03	0.3	35.49	1.2
Pancretan Cooperative	2002-2011	10	1.74	1.42	1.49	0.19	0	0.6
Panellinia	2005-2011	7	1.04	0.78	0.91	0.11	12.34	0.4
Piraeus	1993-2011	19	25.57	17.15	20.84	1.42	332.39	8.8
Proton	2002-2010	9	1.92	0.98	1.59	0.28	19.76	0.7
T Bank	1993-2010	18	2.26	1.58	1.89	0.14	11.55	0.8
TELESIS Investment	1993-2000	8	0.35	0.14	0.25	0.08	1.53	0.1
TT Hellenic Postbank	1998-2011	14	16.51	5.78	14.72	1.32	37.74	5.7
Xiosbank	1993-1998	6	0.93	0.35	0.84	0.05	3.18	0.3
Total		356	292.12	173.29	243.58	18.16	2943.63	100

Notes: This table presents an overview of all the Greek financial intermediaries throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, Mar. Pr represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Power (measured as each bank's share of the indrustry's total assets) respectively. 'B' stands for billions while 'M' for millions.

Table 2.3.a: UK - Descriptive Statistics of the variables of interest.

Variable		Mean	St. Dev	Percentiles	
				5th	95th
Kernel determinants					
Total Cost	tc	1147.161	174.709	804.612	1489.709
Price of borrowed funds	w1	0.126	0.019	0.089	0.163
Price of labor	w2	0.023	0.001	0.021	0.025
Price of physical capital	w3	6.36	0.744	4.901	7.82
Total loans	y1	26154.18	2781.631	20700.58	31607.78
Total earning assets	y2	21727.69	2127.914	17555.82	25899.56
Off-balance sheet items	y3	14404.49	1150.945	12147.57	16661.41
Equity	eq	2925.062	327.158	2283.656	3566.467
Inefficiency determinants					
Time	z1	14.375	0.092	14.194	14.556
Size	z2	48946.8	4949.264	39243.56	58650.03
Class determinants					
Capital adeqaucy	q1	0.157	0.003	0.15	0.163
Liquidity risk	q2	0.511	0.005	0.502	0.521
Credit risk	q3	0.946	0.264	0.427	1.464
Service concentration	q4	0.566	0.004	0.559	0.573
Profitability	q5	0.024	0.013	0.021	0.089

Notes: This table refers to 1,856 observations and 124 UK financial institutions between 1988-2011. The table reports descriptive statistics of the kernel, inefficiency and the class membership variables we use in the estimation of the latent class stochastic cost frontier model (apart from the dummy variable that represents the type of the financial institution, i.e. 'BS') as described in Figure 2.1.a. All monetary variables are deflated using 2005 as a base year. Kernel determinants consist of the dependent variable, i.e. total cost (tc), inputs prices (w), output quantities (q) and equity (eq) as a quasi-fixed input variable. Inefficiency determinants (z) consist of 'Time'= time-trend and 'Size' = bank's real assets. Finally the class ratio, determinants (q) consist of 'Capital adequacy' = equity to assets ratio, 'Liquidity risk' = loans to assets 'Credit risk'= loans loss provisions to total assets ratio and 'Service Concentration' = the sum of the squared ratios of the value of each output to the total value of outputs of each financial institution.

Table 2.3.b: Greece - Descriptive Statistics of the variables of interest.

Variable		Mean	St. Dev	Percentiles	
				5th	95th
Kernel determinants					
Total Cost	tc	392.932	38.422	317.365	468.499
Price of borrowed funds	w1	0.058	0.002	0.054	0.062
Price of labor	w2	0.017	0.0005	0.016	0.018
Price of physical capital	w3	1.549	0.303	0.952	2.146
Total loans	y1	6913.851	625.514	5683.612	8144.091
Total earning assets	y2	4248.469	369.007	3522.74	4974.198
Off-balance sheet items	y3	2899.264	384.447	2142.604	3655.925
Equity	eq	812.078	73.574	667.383	956.773
Inefficiency determinants					
Time	z1	9.938	0.291	9.366	10.51
Size	z2	14750.98	1378.103	12040.71	17461.25
Class determinants					
Capital adeqaucy	q1	0.1	0.005	0.09	0.11
Liquidity risk	q2	0.556	0.01	0.535	0.576
Credit risk	q3	0.127	0.036	0.056	0.197
Service concentration	q4	0.464	0.006	0.453	0.475
Profitability	q5	0.0016	0.0019	0.0022	0.0033

Notes: This table refers to 356 observations and 30 Greek financial institutions between 1993-2011. The table reports descriptive statistics of the kernel, inefficiency and the class membership variables we use in the estimation of the latent class stochastic cost frontier model (apart from the dummy variable that represents the onwership of the financial institution, i.e. 'OWNER') as described in Figure 2.1.b. All monetary variables are deflated using 2005 as a base year. Kernel determinants consist of the dependent variable, i.e. total cost (tc), inputs prices (w), output quantities (q) and equity (eq) as a quasi-fixed input variable. Inefficiency determinants (z) consist of 'Time'= time-trend and 'Size' = bank's real assets. Finally the class determinants (q) consist of 'Capital adequacy' = equity to assets ratio, 'Liquidity risk' = loans to assets ratio, 'Credit risk'= loans loss provisions to total assets ratio and 'Service Concentration' = the sum of the squared ratios of the value of each output to the total value of outputs of each financial institution.

Table 2.4.a: UK - Selection of the number of latent classes

	No. of classes	No. of banks	No. of Param.	Log-Likelihood	AIC	BIC
Pooled Model	1	124	12	-456.9226	0.50998	0.54598
Latent Class	2	73(1) 51(2)	28	-251.6265	0.30411	0.38811

Notes: This table features stochastic frontier model estimations for 1 and 2 latent classes using 1,856 observations and 124 UK financial institutions between 1988-2011. The preferred model is the one with the lowest AIC and BIC statistic.

Table 2.4.b: Greece - Selection of the number of latent classes

	No. of classes	No. of banks	No. of Param.	Log-Likelihood	AIC	BIC
Pooled Model	1	30	12	-4.211612	0.1247	0.28904
Latent Class	2	17(1) 13(2)	28	90.97407	-0.48442	-0.10096

Notes: This table features stochastic frontier model estimations for 1 and 2 latent classes using 356 observations and 30 Greek financial institutions between 1993-2011. The preferred model is the one with the lowest AIC and BIC statistic.

Table 2.5.a: UK - Average cost efficiency indexes with different number of classes

Year	SFM with one Latent class	SFM with two Latent classes
1988	0.48	0.68
1989	0.57	0.69
1990	0.49	0.68
1991	0.49	0.68
1992	0.58	0.67
1993	0.56	0.66
1994	0.58	0.65
1995	0.59	0.65
1996	0.61	0.66
1997	0.58	0.68
1998	0.61	0.7
1999	0.61	0.69
2000	0.58	0.66
2001	0.57	0.65
2002	0.57	0.64
2003	0.58	0.64
2004	0.61	0.65
2005	0.61	0.64
2006	0.61	0.64
2007	0.6	0.62
2008	0.6	0.62
2009	0.58	0.61
2010	0.56	0.59
2011	0.53	0.56
Total	0.57	0.65

Notes: This table reports the average cost efficiency scores for each year of the UK banking industry, which are obtained by estimating stochastic frontier models with one and two technological classes.

Table 2.5.b: Greece - Average cost efficiency indexes with different number of classes

Year	SFM with one Latent class	SFM with two Latent classes
1993	0.63	0.69
1994	0.64	0.68
1995	0.66	0.69
1996	0.71	0.72
1997	0.68	0.76
1998	0.69	0.76
1999	0.67	0.73
2000	0.7	0.72
2001	0.71	0.73
2002	0.7	0.72
2003	0.7	0.71
2004	0.76	0.79
2005	0.73	0.82
2006	0.7	0.83
2007	0.72	0.86
2008	0.7	0.85
2009	0.69	0.84
2010	0.67	0.82
2011	0.64	0.79
Total	0.69	0.76

Notes: This table reports the average cost efficiency scores for each year of the Greek banking industry, which are obtained by estimating stochastic frontier models with one and two technological classes.

Table 2.6.a: UK - Average cost efficiency estimates

	Overall Sample		LCM			
			Class1		Class2	
Year	Mean	Obs.	Mean	Obs.	Mean	Obs.
1988	0.68	6	0.68	6	-	-
1989	0.69	29	0.73	22	0.48	7
1990	0.68	38	0.71	28	0.46	10
1991	0.68	42	0.7	31	0.49	11
1992	0.67	50	0.71	37	0.47	13
1993	0.66	52	0.69	38	0.48	14
1994	0.65	53	0.7	39	0.47	14
1995	0.65	62	0.69	42	0.5	20
1996	0.66	85	0.71	56	0.41	29
1997	0.68	89	0.67	58	0.43	31
1998	0.7	89	0.73	57	0.42	32
1999	0.69	90	0.72	55	0.42	35
2000	0.66	92	0.71	56	0.41	36
2001	0.65	96	0.73	59	0.34	37
2002	0.64	100	0.71	58	0.35	42
2003	0.64	103	0.71	59	0.39	44
2004	0.65	103	0.72	58	0.41	45
2005	0.64	104	0.71	58	0.4	46
2006	0.64	103	0.71	56	0.4	47
2007	0.62	99	0.7	57	0.37	42
2008	0.62	98	0.69	56	0.36	42
2009	0.61	97	0.68	55	0.34	42
2010	0.59	94	0.66	53	0.32	41
2011	0.56	82	0.63	50	0.3	32
Total	0.65	1856	0.7	1144	0.41	712

Notes: This table reports the average cost efficiency estimates for each year of the UK banking industry with respect to the number of financial institutions that belong to the first and to the second technological class.

Table 2.6.b: Greece - Average cost efficiency estimates

	Overall Sample		LCM			
			Class1		Class2	
Year	Mean	Obs.	Mean	Obs.	Mean	Obs.
1993	0.69	21	0.77	13	0.44	8
1994	0.68	21	0.76	13	0.46	8
1995	0.69	21	0.77	13	0.49	8
1996	0.72	21	0.78	13	0.56	8
1997	0.76	21	0.8	13	0.52	8
1998	0.76	20	0.78	12	0.59	8
1999	0.73	16	0.76	8	0.57	8
2000	0.72	15	0.78	7	0.63	8
2001	0.73	16	0.78	7	0.65	9
2002	0.72	19	0.8	8	0.63	11
2003	0.71	20	0.8	9	0.64	11
2004	0.79	20	0.85	9	0.75	11
2005	0.82	20	0.88	9	0.76	11
2006	0.83	18	0.9	9	0.79	9
2007	0.86	18	0.91	9	0.82	9
2008	0.85	18	0.89	9	0.81	9
2009	0.84	18	0.89	9	0.81	9
2010	0.82	18	0.86	9	0.79	9
2011	0.79	15	0.83	8	0.77	7
Total	0.76	356	0.82	187	0.66	169

Notes: This table reports the average cost efficiency estimates for each year of the Greek banking industry with respect to the number of financial institutions that belong to the first and to the second technological class.

Table 2.7.a: UK - Latent cost frontier, inefficiency, and class determinants estimates

Technology Class	1		2	
	Coefficient	b/St.Er.	Coefficient	b/St.Er.
Kernel determinants				
Constant	1.585	22.288	0.447	4.311
LNP1	0.059	7.732	0.07	2.495
LNP2	0.872	83.717	0.662	33.423
LNY1	0.482	33.109	0.292	8.623
LNY2	0.303	23.577	0.251	10.341
LNY3	-0.031	-4.045	-0.039	-2.141
LNEQ	0.183	9.549	0.32	4.681
Trend	-0.001	-0.647	0.013	2.036
Ineffficient determinants				
TIME	-0.056	-5.589	0.047	3.153
SIZE	0.225	8.473	0.165	3.056
BS	-0.884	-2.207	0.007	0.005
Class determinants				
CONSTANT	0.78	5.944	Control Group	
CAPITAL ADEQUACY	0.568	6.056	Control Group	
LIQUIDITY RISK	-0.736	4.694	Control Group	
CREDIT RISK	-0.263	-4.513	Control Group	
SERV_CON	-0.628	-3.637	Control Group	
PROFITABILTY	1.472	0.864	Control Group	
Sigma	0.181	4.837	0.388	5.876
Lambda	0.358	0.608	0.307	1.044
Number of observations	1144		712	
Prior class probabilities at data means	0.573		0.427	

Notes: The table feautures latent cost frontier, inefficiency, and class determinants estimates of 1856 observations for 124 UK financial institutions in the period 1988-2011. The estimation is conducted under a panel data nature methodology (Orea and Kumbhakar 2004) which allows the efficiency term to vary every year. Dependent variable is lnTC/lnW3. Log likelihood is -456.9226. Lamda (λ) and Sigma (σ) are efficient parameters, where λ (= σu/σv), the ratio of the standard deviation of efficiency over the standard deviation of the noise term, and σ (= σu+σv), the composite standard deviation. The variables are as described in Table 2.3.a.

Table 2.7.b: Greece - Latent cost frontier, inefficiency, and class determinants estimates

Technology Class	1		2	
	Coefficient	b/St.Er.	Coefficient	b/St.Er.
Kernel determinants				
Constant	0.933	5.502	0.346	10.479
LNP1	0.042	6.286	0.713	12.876
LNP2	0.852	18.514	1.026	10.808
LNY1	0.529	10.5	0.626	8.171
LNY2	0.352	7.214	0.292	2.597
LNY3	-0.017	-4.862	0.087	5.383
LNEQ	0.133	3.034	0.023	4.156
Trend	0.177	1.851	0.104	2.722
Ineffficient determinants				
TIME	-0.075	-3.244	-0.143	-3.969
SIZE	0.694	6.298	0.297	2.879
Owner	0.267	0.435	0.703	0.33
Class determinants				
CONSTANT	1.276	2.609	Control Group	
CAPITAL ADEQUACY	0.547	4.831	Control Group	
LIQUIDITY RISK	-0.947	-5.874	Control Group	
CREDIT RISK	-0.686	-3.039	Control Group	
SERV_CON	-0.097	-0.982	Control Group	
PROFITABILTY	0.001	0.222	Control Group	
Sigma	0.948	11.63	0.974	26.655
Lambda	0.118	0.422	0.24	0.402
Number of observations	187		169	
Prior class probabilities at data means	0.625		0.375	

Notes: The table feautures latent cost frontier, inefficiency, and class determinants estimates of 356 observations for 30 Greek financial institutions in the period 1993-2011. The estimation is conducted under a panel data nature methodology (Orea and Kumbhakar 2004) which allows the efficiency term to vary every year. Dependent variable is lnTC/lnW3. Log likelihood is 90.97407. Lamda (λ) and Sigma (σ) are efficient parameters, where λ (= σu/σv), the ratio of the standard deviation of efficiency over the standard deviation of the noise term, and σ (= σu+σv), the composite standard deviation. The variables are as described in Table 2.3.b.

Table 2.8.a: UK - Economies of Scale & Technical change

	OVERALL SAMPLE		LCM Class 1		Class 2	
	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
Economies of scale	0.042	2.023	0.002	1.189	0.096	7.569
Technical Change	-0.317	-6.012	-0.181	-5.647	-0.132	-1.836

Notes: This table feautures 1856 observations for 124 UK financial institutions in the period 1988-2011. Economies of Scale are estimated as one minus the sum of elasticities of total costs with respect to outputs. Technical change is etimated as the derivative of total costs with respect to time.

Table 2.8.b: Greece - Economies of Scale & Technical change

	OVERALL SAMPLE		LCM Class 1		Class 2	
	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
Economies of scale	0.071	3.287	0.053	3.896	0.136	4.863
Technical Change	-0.104	-2 .989	-0.177	-4.851	-0.705	-1.322

Notes: This table feautures 356 observations for 30 Greek financial institutions in the period 1993-2011. Economies of Scale are estimated as one minus the sum of elasticities of total costs with respect to outputs. Technical change is etimated as the derivative of total costs with respect to time.

Table 2.9.a: UK - Classification of banks

	Latent Class 1				Latent Class 2		
	name	Years	Num OBS		name	Years	Num OBS
_1	ABC Int.	1996-2011	16	_1	AIB Group	1995-2011	17
_2	AIB Bank	1992-2008	17	_2	Abbey Nat.	1990-2011	22
_3	Adam & Company	1989-2011	23	_3	Alliance & Leic. Bank	1995-2006	12
_4	Ahli United	1989-2011	23	_4	Alpha Bank	1989-2011	23
_5	Alliance & Leic. Plc	1996-2011	16	_5	Anglo-Romanian	1989-2010	22
_6	Arbuthnot	1991-2011	21	_6	BMCE Int.	2006-2011	6
_7	Bank of China	2007-2011	5	_7	Bank Leumi	1996-2011	16
_8	Bank of Cyprus	1997-2003	7	_8	Bank Mandiri	1999-2011	13
_9	Bank of Tokyo	1988-1996	9	_9	Bank Saderat	1996-2011	16
_10	Barclays Bank	1992-2011	20	_10	Bank of Beirut	2002-2011	10
_11	Barclays Priv. & Tr.	2002-2005	4	_11	Bank of N.Y. Mellon	1997-2011	15
_12	Bath BS Sav. & Inv.	1995-2010	16	_12	Bank of Scotland	1990-2011	22
_13	Beneficial Bank	1988-1998	11	_13	Barclays Priv. Clien.	2002-2008	7
_14	Britannia BS	1989-2009	21	_14	Bradford & Bingley Bank	1999-2011	13
_15	Buckinghamshire BS	2003-2011	9	_15	British Arab	1989-2011	23
_16	Butterfield Guernsey	1996-2011	16	_16	Butterfield Holdings	1992-2010	19
_17	Cambridge BS	1996-2011	16	_17	Capital One	2002-2011	10
_18	Cheshire BS	1990-2007	18	_18	Chelsea BS	1990-2009	20
_19	Co-operative	1990-2011	22	_19	Citibank	1989-2011	23
_20	Coventry BS	1989-2011	23	_20	Cuscatlan Bank and Trust	2002-2006	5
_21	Credit Suisse	1997-2011	15	_21	DB UK	1996-2011	16
_22	Darlington BS	1996-2011	16	_22	Dunbar	1995-2010	16
_23	Dexia Municipal	1992-1999	8	_23	Egg	1996-2011	16
_24	Duncan Lawrie	2008-2010	3	_24	Europe Arab	2005-2011	7
_25	Dunfermline BS	1992-2007	16	_25	FBN	2003-2011	9
_26	FIBI	1996-2011	16	_26	Fairbairn	1998-2011	14
_27	Ghana	1998-2011	14	_27	Finsbury Pavement	1991-2006	16
_28	HSBC Middle East	1989-2011	23	_28	Gresham Trust	1993-2000	8
_29	HSBC	1989-2011	23	_29	HBOS	2000-2011	12
_30	Habib Allied	2001-2011	11	_30	Halifax	1996-2006	11
_31	Habibsons	1996-2011	16	_31	Heritable	1989-2007	19
_32	Isle of Man Bank Limited	1995-2011	17	_32	ICBC	2003-2011	9
_33	Italian Int.	1988-1997	10	_33	JP Morgan	1996-2011	16
_34	Kaupthing Singer & Friedlander	1989-2007	19	_34	Jordan Int.	1996-2011	16
_35	Kingdom	2009-2011	3	_35	KDB Bank	1992-1998	7
_36	Leeds BS	1989-2011	23	_36	Kookmin	1995-2010	16
_37	Lloyds (BLSA)	1992-2001	10	_37	Lazard & Co Holdings	1999-2011	13
_38	Lloyds	1988-1998	11	_38	London Int.	2001-2006	6
_39	Lloyds TSB	1998-2011	14	_39	MBNA Europe Bank	1995-2010	16
_40	Lloyds TSB Scotland	1989-2010	22	_40	Morgan Stanley	2001-2011	11
_41	London Trust	1991-1998	8	_41	Northern	1995-2010	16
_42	Manchester BS	1990-2011	22	_42	Northern Rock	1996-2011	16
_43	Marsden BS	1996-2011	16	_43	PNB	1997-2011	15
_44	Melli	2001-2011	11	_44	Progressive BS	1996-2011	16
_45	Melton Mowbray BS	1996-2011	16	_45	Riggs	1989-2004	16
_46	Merrill Lynch	1990-2005	16	_46	Sainsbury's	2002-2011	10
_47	National Bank of Kuwait	1996-2011	16	_47	The Access	2008-2011	4
_48	National Counties BS	1996-2011	16	_48	Ulster	1989-2011	23
_49	National Westminster	1989-2011	23	_49	Union	2005-2011	7
_50	Nationwide BS	1990-2011	22	_50	United Trust	1999-2011	13

(Continued)

Table 2.9.a: UK - Classification of banks (Continued)

	Latent Class 1				Latent Class 2		
	name	Years	Num OBS		name	Years	Num OBS
_51	Newcastle BS	1989-2011	23	_51	VTB Capital	2004-2011	8
_52	Nottingham BS	1992-2011	20				
_53	Principality BS	1989-2011	23				
_54	Prudential-Bache	1996-2001	6				
_55	Riyad	1993-1997	5				
_56	Royal Bank of Scotland Int.	1996-2008	13				
_57	Royal Bank of Scotland	1995-2011	17				
_58	Santander	1989-2011	23				
_59	Schroders	1989-2011	23				
_60	Secure Trust	1999-2011	13				
_61	Skipton BS	1989-2011	23				
_62	Standard	2000-2011	12				
_63	Standard Chartered	1998-2011	14				
_64	Standard Chartered Plc	1990-2011	22				
_65	Stroud & Swindon BS	1994-2009	16				
_66	Swansea BS	1996-2011	16				
_67	TSB	1988-1997	10				
_68	Turkish	1996-2011	16				
_69	United National	2001-2011	11				
_70	Unity Trust	1991-2011	21				
_71	Weatherbys	1997-2011	15				
_72	West Merchant	1988-1997	10				
_73	Yorkshire BS	1989-2011	23				
	Total		1144				712

Notes: This table reports the classification of 124 UK financial institutions for the period 1988-2011 into the two latent technological classes according to the regime membership determinants desribed in Table 2.3.a.

Table 2.9.b: Greece - Classification of banks

	Latent Class 1 name	Years	Num OBS		Latent Class 2 name	Years	Num OBS
_1	Aegean Baltic	2003-2011	9	_1	Agricultural (ATE)	1993-2011	19
_2	Alpha	1993-2011	19	_2	Attica	1993-2011	19
_3	Bank of Athens	1993-1997	5	_3	Emporiki (Commercial)	1993-2011	19
_4	Bank of Central Greece	1993-1998	6	_4	FBB First Business	2002-2011	10
_5	Bank of Crete (Cretabank)	1993-1998	6	_5	General	1993-2011	19
_6	Ergobank	1993-1999	7	_6	Laiki	1993-2005	13
_7	Eurobank Ergasias	1993-2011	19	_7	Macedonia Thrace	1993-1999	7
_8	Ionian and Popular	1993-1998	6	_8	Marfin	1993-2005	13
_9	National Bank of Greece (Ethiki)	1993-2011	19	_9	Marfin Egnatia	1993-2010	18
_10	National Mortgage Bank	1993-1997	5	_10	Millennium	2000-2011	12
_11	PRObank	2001-2011	11	_11	Omega	2001-2004	4
_12	Pancretan Cooperative	2002-2011	10	_12	Panellinia	2005-2011	7
_13	Piraeus	1993-2011	19	_13	Proton	2002-2010	9
_14	T Bank	1993-2010	18				
_15	TELESIS Investment	1993-2000	8				
_16	TT Hellenic Postbank	1998-2011	14				
_17	Xiosbank	1993-1998	6				
	Total		187				169

Notes: This table reports the classification of 30 UK financial institutions for the period 1993-2011 into the two latent technological classes according to the regime membership determinants desribed in Table 2.3.b.

Table 2.10.a: UK - "Pooled-Cross Section Data", Latent cost frontier and class determinants estimates

Technology Class	1		2	
	Coefficient	b/St.Er.	Coefficient	b/St.Er.
Kernel determinants				
Constant	1.782	24.642	0.732	5.249
LNP1	0.081	8.019	0.076	2.893
LNP2	0.928	92.761	0.676	23.884
LNY1	0.491	36.534	0.292	8.623
LNY2	0.303	23.577	0.428	15.093
LNY3	-0.035	-4.824	-0.063	-3.691
LNEQ	0.183	9.549	0.32	4.682
Trend	0.009	4.37	0.054	2.847
Class determinants				
CONSTANT	1.025	7.864	Control Group	
CAPITAL ADEQUACY	0.894	8.186	Control Group	
LIQUIDITY RISK	-0.942	5.138	Control Group	
CREDIT RISK	-0.648	-4.975	Control Group	
SERV_CON	-0.849	-4.013	Control Group	
PROFITABILTY	1.188	3.046	Control Group	
Sigma	0.236	7.317	0.658	11.914
Lambda	0.748	0.964	0.483	1.204
Number of observations	1144		712	
Prior class probabilities at data means	0.573		0.427	

Notes: The tablepresents latent cost frontier, inefficiency, and class determinants estimates of 1856 observations for 124 UK financial institutions in the period 1988-2011. The estimation is conducted under a pooled cross-section methodology (Bos et al. 2010) which permits each financial institution to switch between technology regimes over time. Dependent variable is lnTC/lnW3. Log likelihood is -431.6557. Lamda (λ) and Sigma (σ) are efficient parameters, where λ (= σu/σv), the ratio of the standard deviation of efficiency over the standard deviation of the noise term, and σ (= σu+σv), the composite standard deviation. The variables are as described in Table 2.3.a.

Table 2.10.b: Greece - "Pooled-Cross Section Data", Latent cost frontier and class determinants estimates

Technology Class	1		2	
	Coefficient	b/St.Er.	Coefficient	b/St.Er.
Kernel determinants				
Constant	1.024	5.749	0.412	11.723
LNP1	0.051	6.476	0.787	13.244
LNP2	0.938	19.247	1.122	11.625
LNY1	0.604	11.264	0.714	8.668
LNY2	0.378	7.461	0.313	2.934
LNY3	-0.019	-4.903	0.091	5.427
LNEQ	0.144	3.854	0.051	4.764
Trend	0.204	2.314	0.187	2.876
Class determinants				
CONSTANT	1.258	2.897	Control Group	
CAPITAL ADEQUACY	0.639	4.924	Control Group	
LIQUIDITY RISK	-1.014	-6.013	Control Group	
CREDIT RISK	-0.816	-3.944	Control Group	
SERV_CON	-0.849	-2.975	Control Group	
PROFITABILTY	0.758	2.496	Control Group	
Sigma	0.988	13.47	1.013	27.486
Lambda	0.247	0.549	0.285	0.501
Number of observations	187		169	
Prior class probabilities at data means	0.642		0.358	

Notes: The tablepresents latent cost frontier, inefficiency, and class determinants estimates of 356 observations for 30 Greek financial institutions in the period 1993-2011. The estimation is conducted under a pooled cross-section methodology (Bos et al. 2010) which permits each financial institution to switch between technology regimes over time. Dependent variable is lnTC/lnW3. Log likelihood is 98.4726. Lamda (λ) and Sigma (σ) are efficient parameters, where λ (= $\sigma u/\sigma v$), the ratio of the standard deviation of efficiency over the standard deviation of the noise term, and σ (= $\sigma u+\sigma v$), the composite standard deviation. The variables are as described in Table 2.3.b.

Table 2.11.a: UK - Classification of banks before the financial crisis

	Latent Class 1				Latent Class 2		
	name	Years	Num OBS		name	Years	Num OBS
_1	ABC Int.	1996-2006	11	_1	AIB Group	1995-2006	12
_2	AIB Bank	1992-2006	15	_2	Abbey Nat.	1990-2006	17
_3	Adam & Company	1989-2006	18	_3	Alliance & Leic. Bank	1995-2006	12
_4	Ahli United	1989-2006	18	_4	Alpha Bank	1989-2006	18
_5	Alliance & Leic. Plc	1996-2006	11	_5	Anglo-Romanian	1989-2006	18
_6	Arbuthnot	1991-2006	16	_6	Bank Leumi	1996-2006	11
_7	Bank of Cyprus	1997-2003	7	_7	Bank Mandiri	1999-2006	8
_8	Bank of Tokyo	1988-1996	9	_8	Bank Saderat	1996-2006	11
_9	Barclays Bank	1992-2006	15	_9	Bank of Beirut	2002-2006	5
_10	Barclays Priv. & Tr.	2002-2005	4	_10	Bank of N.Y. Mellon	1997-2006	10
_11	Bath BS Sav. & Inv.	1995-2006	12	_11	Barclays Priv. Clien.	2002-2006	5
_12	Beneficial Bank	1988-1998	11	_12	British Arab	1989-2006	18
_13	Britannia BS	1989-2006	18	_13	Butterfield Holdings	1992-2006	15
_14	Buckinghamshire BS	2003-2006	4	_14	Cuscatlan Bank and Trust	2002-2006	5
_15	Butterfield Guernsey	1996-2006	11	_15	DB UK	1996-2006	11
_16	Cambridge BS	1996-2006	11	_16	Dunbar	1995-2006	12
_17	Cheshire BS	1990-2006	17	_17	Egg	1996-2006	11
_18	Co-operative	1990-2006	17	_18	FBN	2003-2006	4
_19	Coventry BS	1989-2006	18	_19	Fairbairn	1998-2006	9
_20	Credit Suisse	1997-2006	10	_20	Finsbury Pavement	1991-2006	16
_21	Darlington BS	1996-2006	11	_21	Gresham Trust	1993-2000	8
_22	Dexia Municipal	1992-1999	8	_22	Halifax	1996-2006	11
_23	Dunfermline BS	1992-2006	15	_23	Heritable	1989-2006	18
_24	FIBI	1996-2006	11	_24	ICBC	2003-2006	4
_25	HSBC Middle East	1989-2006	18	_25	JP Morgan	1996-2006	11
_26	HSBC	1989-2006	18	_26	Jordan Int.	1996-2006	11
_27	Habib Allied	2001-2006	6	_27	KDB Bank	1992-1998	7
_28	Habibsons	1996-2006	11	_28	Kookmin	1995-2006	12
_29	Isle of Man Bank Limited	1995-2006	12	_29	Lazard & Co Holdings	1999-2006	8
_30	Italian Int.	1988-1997	10	_30	London Int.	2001-2006	6
_31	Kaupthing Singer & Friedlander	1989-2006	18	_31	Morgan Stanley	2001-2006	6
_32	Leeds BS	1989-2006	18	_32	PNB	1997-2006	10
_33	Lloyds (BLSA)	1992-2001	10	_33	Progressive BS	1996-2006	11
_34	Lloyds	1988-1998	11	_34	Riggs	1989-2004	16
_35	Lloyds TSB	1998-2006	9	_35	Sainsbury's	2002-2006	5
_36	Lloyds TSB Scotland	1989-2006	17	_37	United Trust	1999-2006	8
_37	London Trust	1991-1998	8	_38	VTB Capital	2004-2006	3
_38	Manchester BS	1990-2006	17	_39	**Ghana**	1998-2006	9
_39	Marsden BS	1996-2006	11	_40	**Riyad**	1993-1997	5
_40	Melli	2001-2006	6	_41	**United National**	2001-2006	6
_41	Melton Mowbray BS	1996-2006	11				
_42	Merrill Lynch	1990-2005	16				
_43	National Bank of Kuwait	1996-2006	11				
_44	National Counties BS	1996-2006	11				
_45	National Westminster	1989-2006	17				
_46	Nationwide BS	1990-2006	17				
_47	Newcastle BS	1989-2006	18				
_48	Nottingham BS	1992-2006	15				
_49	Principality BS	1989-2006	18				
_50	Prudential-Bache	1996-2001	6				

(Continued)

Table 2.11.a: UK - Classification of banks before the financial crisis (Continued)

	Latent Class 1			Latent Class 2		
	name	Years	Num OBS	name	Years	Num OBS
_51	Royal Bank of Scotland Int.	1996-2006	11			
_52	Royal Bank of Scotland	1995-2006	12			
_53	Santander	1989-2006	18			
_54	Schroders	1989-2006	18			
_55	Secure Trust	1999-2006	8			
_56	Skipton BS	1989-2006	18			
_57	Standard	2000-2006	7			
_58	Standard Chartered	1998-2006	9			
_59	Standard Chartered Plc	1990-2006	17			
_60	Stroud & Swindon BS	1994-2006	13			
_61	Swansea BS	1996-2006	11			
_62	TSB	1988-1997	10			
_63	Turkish	1996-2006	11			
_64	Unity Trust	1991-2006	16			
_65	Weatherbys	1997-2006	10			
_66	West Merchant	1988-1997	10			
_67	Yorkshire BS	1989-2006	18			
_68	**Bank of Scotland**	1990-2006	17			
_69	**Bradford & Bingley Bank**	1999-2006	8			
_70	**Capital One**	2002-2006	5			
_71	**Chelsea BS**	1990-2006	17			
_72	**Citibank**	1989-2006	18			
_73	**HBOS**	2000-2006	7			
_74	**MBNA Europe Bank**	1995-2006	12			
_75	**Northern**	1995-2006	12			
_76	**Northern Rock**	1996-2006	11			
_77	**Ulster**	1989-2006	18			
	Total		980			403

Notes: This table reports the classification of 118 UK financial institutions for the period 1988-2006 (i.e. before the financial crisis) into the two latent technological classes according to the regime membership determinants desribed in Table 2.3.a. Those financial insitutions that change class (compared with their previous classification where the sample was up to 2011 as diplayed in table 2.9.a) are labeled with a bold font.

Table 2.11.b: Greece - Classification of banks before the financial crisis

	Latent Class 1				Latent Class 2		
	name	Years	Num OBS		name	Years	Num OBS
_1	Aegean Baltic	2003-2006	4	_1	Agricultural (ATE)	1993-2006	14
_2	Alpha	1993-2006	14	_2	Attica	1993-2006	14
_3	Bank of Athens	1993-1997	5	_3	Emporiki (Commercial)	1993-2006	14
_4	Bank of Central Greece	1993-1998	6	_4	FBB First Business	2002-2006	5
_5	Bank of Crete (Cretabank)	1993-1998	6	_5	General	1993-2006	14
_6	Ergobank	1993-1999	7	_6	Laiki	1993-2005	13
_7	Eurobank Ergasias	1993-2006	14	_7	Macedonia Thrace	1993-1999	7
_8	Ionian and Popular	1993-1998	6	_8	Marfin	1993-2005	13
_9	National Bank of Greece (Ethiki)	1993-2006	14	_9	Marfin Egnatia	1993-2006	14
_10	National Mortgage Bank	1993-1997	5	_10	Omega	2001-2004	4
_11	PRObank	2001-2006	6	_11	Proton	2002-2006	5
_12	Pancretan Cooperative	2002-2006	5				
_13	Piraeus	1993-2006	14				
_14	T Bank	1993-2006	14				
_15	TELESIS Investment	1993-2000	8				
_16	TT Hellenic Postbank	1998-2006	9				
_17	Xiosbank	1993-1998	6				
_18	**Millennium**	2000-2006	7				
	Total		150				117

Notes: This table reports the classification of 29 Greek financial institutions for the period 1993-2006 (i.e. before the financial crisis) into the two latent technological classes according to the regime membership determinants desribed in Table 2.3.b. Those financial insitutions that change class (compared with their previous classification where the sample was up to 2011 as diplayed in table 2.9.b) are labeled with a bold font.

Table 2.12: GREECE - M&As & Structure of the banking sector

Systemic Banks	*M&As*	*Year of the M&A activity*
ALPHA BANK	EMPORIKI	2012
EUROBANK	NEW PROTON BANK, NEW TT-HELLENIC POSTBANK	2013 (Both financial institutions)
ETHNIKI BANK	FBB, PROBANK	2013 (Both financial institutions)
PIRAEUS BANK	ATE BANK, GENIKI BANK, MARFIN_EGNATIA, MILLENIUM	2012 : ATE BANK and GENIKI Bank
		2013: MARFIN- EGNATIA and MILLENIUM
Remaining Banks	*Type*	
ATTICA	Commercial	
AEGEAN	Commercial	
PANELLINIA	Commercial created by Co-operatives banks	
PANCRETAN	Co-operative	

Notes: This table reports detailed information about the recent wave of M&As where the 'big-four' of the Greek banking sector, i.e. ALPHA BANK, EUROBANK, ETHNIKI BANK and PIRAEUS BANK, were involved and resulted to the creation of the four 'systemic' banks. Additionally, the table presents the financial intermediaries and their business model that constitute the current structure of the Greek banking sector. As far as "ATE BANK, NEW PROTON BANK, NEW TT-HELLENIC POSTBANK, FBB and PROBANK" are concerned, only the 'healthy' part of assets and liabilities of those financial institutions was acquired by the . It should be noted that PIRAEUS BANK acquired in 2013 'CYPRUS BANK' and 'HELLENIC BANK' as well, however due to unavailability of data we do not include these two cases. 'ETHNIKI' stands for the 'NATIONAL BANK OF GREECE' while MARFIN_EGNATIA' stands for 'CYPRUS POPULAR BANK (LAIKI BANK)'. Finally, there are a few more 'Co-operative' type banks which we do not quote them as their aggregate market share is less than 2% in assets, deposits and loans of the whole banking sector.

Table 2.13: UK - 20 Largest banks in both regimes in the end of 2011

	Class 1		Class 2
_1	Barclays Bank	_1	Alpha Bank
_2	Co-operative	_2	The Access
_3	HSBC	_3	Bank of Beirut
_4	Habib Allied	_4	Citibank
_5	Lloyds TSB	_5	DB UK
_6	Nationwide BS	_6	Europe Arab
_7	Royal Bank of Scotland	_7	Bank Leumi
_8	Santander	_8	Bank of N.Y. Mellon
_9	Standard Chartered	_9	Progressive BS
		_10	Sainsbury's
		_11	Union

Notes: This table presents the classification among the two different techonlogical latent classes of the 20 largest UK financial institutions that were used in the analysis of the prospective M&As scenarios. Specifically, all potential consolidation activities consist of combinations of financial intermediaries that belong either in different technological regimes, or in the second (i.e. less efficient) latent class.

Table 2.14.a: UK - Hypothetical M&As Scenarios

	*Potential M&As among banks in **both classes***	Class		*Potential M&As among banks in the **2nd class***	Class
_1	ALPHA-ACCESS	2	_1	BARCLAYS-ACCESS	2
_2	ALPHA-BEIRUT	1	_2	BARCLAYS-ALPHA	1
_3	ALPHA-CITIBANK	1	_3	BARCLAYS-LEUMI	1
_4	ALPHA-DBUKBANK	2	_4	BARCLAYS-BEIRUT	1
_5	ALPHA-EUROPEARAB	2	_5	BARCLAYS-CITIBANK	2
_6	ALPHA-LEUMI	1	_6	BARCLAYS-DBUKBANK	2
_7	ALPHA-BAN OF NEW YORK	2	_7	BARCLAYS-EUROEPARAB	1
_8	ALPHA-PROGRESSIVE	1	_8	BARCLAYS-NEWYORK	2
_9	ALPHA-SAINSBURY'S	2	_9	BARCLAYS-PROGRESSIVE	1
_10	ALPHA-UNION	2	_10	BARCLAYS-SAINSBURY'S	1
_11	LEUMI-ACCESS	2	_11	BARCLAYS-UNION	2
_12	LEUMI-BEIRUT	1	_12	CO-OPERATIVE-ACCESS	2
_13	LEUMI-CITIBANK	1	_13	CO-OPERATIVE-ALPHA	1
_14	LEUMI-DBUKBANK	2	_14	CO-OPRATIVE-BEIRUT	1
_15	LEUMI-EUROPE	2	_15	CO-OPERATIVE-CITIBANK	2
_16	LEUMI-NEW_YORK	2	_16	CO-OPERATIVE-DBUKBANK	2
_17	LEUMI-PROGRESSIVE	1	_17	CO-OPERATIVE-EUROPEARAB	2
_18	LEUMI-SAINSBURY'S	2	_18	CO-OPERATIVE-LEUMI	1
_19	LEUMI-UNION	2	_19	CO-OPERATIVE-NEW_YORK	2
_20	BEIRUT-ACCESS	1	_20	CO-OPERATIVE-PROGRESSIVE	2
_21	BEIRUT-CITIBANKJ	1	_21	CO-OPERATIVE-SAINBURY'S	2
_22	BEIRUT-DBUKBANK	2	_22	CO-OPERATIVE-UNION	2
_23	BEIRUT-EUROPEARAB	2	_23	HABIB-ALPHA	1
_24	BEIRUT-NEWYORK	2	_24	HABIB-BEIRUT	1
_25	BEIRUT-PROGRESSIVE	1	_25	HABIB-LEUMI	1
_26	BEIRUT-SAINSBURY'S	2	_26	HABIB-ACCESS	2
_27	BEIRUT-UNION	2	_27	HABIB-CITIBANK	2
_28	NEW_YORK-ACCESS	2	_28	HABIB-DBUKBANK	2
_29	NEW_YORK-CITIBANK	2	_29	HABIB-EUROPE	2
_30	NEW_YORK-DBUKBANK	2	_30	HABIB-NEW_YORK	2
_31	NEW_YORK-EUROPE	2	_31	HABIB-PROGRESSIVE	1
_32	NEW_YORK-PROGRESSIVE	2	_32	HABIB-SAINSBURY'S	2
_33	NEW_YORK-SAIBURY'S	2	_33	HABIB-UNION	2
_34	NEW_YORK-UNION	2	_34	HSBC-ACCESS	2
_35	CITIBANK-ACCESS	2	_35	HSBC-ALPHA	1
_36	CITIBANK-DBUKBANK	2	_36	HSBC-BEIRUT	1
_37	CITIBANK-EUROPEARAB	2	_37	HSBC-CITIBANK	1
_38	CITIBANK-PROGRESSIVE	1	_38	HSBC-DBUKBANK	2
_39	CITIBANK-SAINBURY'S	1	_39	HSBC-EUROPE	2
_40	CITIBANK-UNION	2	_40	HSBC-LEUMI	1
_41	DBUKBANK-EUROPEARAB	2	_41	HSBC-NEW_YORK	2
_42	DBUKBANK-PROGRESSIVE	1	_42	HSBC-PROGRESSIVE	1
_43	DBUKBANK-SAINSBURY'S	2	_43	HSBC-SAINSBURY'S	1
_44	DBUKBANK-ACCESS	2	_44	HSBC-UNION	2
_45	DBUKBANK-UNION	2	_45	LlOYDS-ACCESS	2
_46	EUROPE-PROGRESSIVE	1	_46	LlOYDS-ALPHA	1
_47	EUROPE-SAINSBURY'S	2	_47	LlOYDS-BEIRUT	1
_48	EUROPE-ACCESS	2	_48	LlOYDS-CITIBANK	2
_49	EUROPE-UNION	2	_49	LlOYDS-DBUKBANK	2
_50	PROGRESSIVE-ACCESS	2	_50	LlOYDS-EUROPE	2
_51	PROGRESSIVE-SAINSBURY'S	2	_51	LlOYDS-LEUMI	2
_52	PROGRESSIVE-UNION	1	_52	LlOYDS-NEW_YORK	2

(continued)

Table 2.14.a: UK - Hypothetical M&As Scenarios (Continued)

	*Potential M&As among banks in **both classes***	Class		*Potential M&As among banks in the **2nd class***	Class
_53	SAINSBURY'S -ACCESS	2	_53	LlOYDS-PROGRESSIVE	2
_54	SAINSBURY'S -UNION	2	_54	LlOYDS-SAINSBURY'S	2
_55	ACCESS-UNION	2	_55	LlOYDS-UNION	2
			_56	NATIONWIDE-ACCESS	2
			_57	NATIONWIDE-ALPHA	1
			_58	NATIONWIDE-BEIRUT	1
			_59	NATIONWIDE-CITIBANK	1
			_60	NATIONWIDE-DBUKBANK	2
			_61	NATIONWIDE-EUROPE	1
			_62	NATIONWIDE-LEUMI	1
			_63	NATIONWIDE-NEW YORK	1
			_64	NATIONWIDE-PROGRESSIVE	1
			_65	NATIONWIDE-SAINSBURY'S	1
			_66	NATIONWIDE-UNION	1
			_67	RBS-ACCESS	2
			_68	RBS-ALPHA	2
			_69	RBS-BEIRUT	1
			_70	RBS-CITIBANK	2
			_71	RBS-DBUKBANK	2
			_72	RBS-EUROPE	2
			_73	RBS-LEUMI	1
			_74	RBS-NEW_YORK	2
			_75	RBS-PROGRESSIVE	1
			_76	RBS-SAINSBURY'S	2
			_77	RBS-UNION	2
			_78	SANTANDER-ACCESS	2
			_79	SANTANDER-ALPHA	1
			_80	SANTANDER-BEIRUT	1
			_81	SANTANDER-CITIBANK	2
			_82	SANTANDER-DBUKBANK	2
			_83	SANTANDER-EUROPE	2
			_84	SANTANDER-LEUMI	1
			_85	SANTANDER-NEW_YORK	2
			_86	SANTANDER-PROGRESSIVE	2
			_87	SANTANDER-SAINSBURY'S	2
			_88	SANTANDER-UNION	2
			_89	STANDARD-ACCESS	2
			_90	STANDARD-ALPHA	1
			_91	STANDARD-BEIRUT	1
			_92	STANDARD-CITIBANK	2
			_93	STANDARD-DBUKBANK	2
			_94	STANDARD-EUROPE	2
			_95	STANDARD-LEUMI	2
			_96	STANDARD-NEW_YORK	2
			_97	STANDARD-PROGRESSIVE	1
			_98	STANDARD-SAINSBURY'S	1
			_99	STANDARD-UNION	2

Notes: This table reports all the prospective scenarios of M&As among 20 UK financial institutions and the classification of the 'new' financial entity into the two latent technological classes according to the regime membership determinants described in Table 2.3.a. Specifically, we select the nine most important financial intermediaries in terms of assets, deposits and loans that belong to the most efficient technological regime (i.e. the first one) and the eleven most important from the second technologically and less efficient class after we ensure that each of these latter twenty banks is not a subsidiary of the remaining nineteen. The first column presents all possible combinations of consolidation between those financial institutions that belong to different technological class, while the second column reposts all possible combinations of consolidation between those financial institutions that belong to the second and less efficient technological regime.

Table 2.14.b: Greece - Hypothetical M&As Scenarios

	RECENT - M&As	CLASS		*POTENTIAL - M&As*	CLASS
_1	ALPHA-EMPORIKI	1	_1	ALPHA-ATTICA	1
_2	EUROBANK-PROTON-TT_HELLENIC	2	_2	ALPHA-AEGEAN	1
_3	ETHNIKI-FFB-PROBANK	1	_3	ALPHA-PANELLINIA	1
_4	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM	2	_4	ALPHA-PANCRETAN	1
			_5	ALPHA-EMPORIKI-ATTICA	2
			_6	ALPHA-EMPORIKI-AEGEAN	2
	RECENT (POTENTIAL) - M&As		_7	ALPHA-EMPORIKI-PANELLINIA	1
_1	EUROBANK-PROTON	2	_8	ALPHA-EMPORIKI-PANCRETAN	1
_2	EUROBANK-TT_HELLENIC	1	_9	ALPHA-EMPORIKI-ATTICA-AEGEAN	2
_3	ETHNIKI-FBB	1	_10	ALPHA-EMPORIKI-ATTICA-PANELLINIA	2
_4	ETHNIKI-PROBANK	1	_11	ALPHA-EMPORIKI-ATTICA-PANCRETAN	2
_5	PIRAEUS-ATE	2	_12	ALPHA-EMPORIKI-AEGEAN-PANNELINIA	1
_6	PIRAEUS-MARFIN_EGNATIA	1	_13	ALPHA-EMPORIKI-AEGEAN-PANCRETAN	1
_7	PIRAEUS-MILLENIUM	1	_14	ALPHA-EMPORIKI-PANELLINIA-PANCRETAN	2
_8	PIRAEUS-GENIKI	2	_15	ALPHA-EMPORIKI-ATTICA-AEGEAN-PANELLINIA	2
_9	PIRAEUS-ATE-GENIKI	2	_16	ALPHA-EMPORIKI-AEGEAN-ATTICA-PANCRETAN	2
_10	PIRAEUS-MILLENIUM-GENIKI	2	_17	ALPHA-EMPORIKI-AEGEAN-PANELLINIA-PANCRETAN	2
_11	PIRAEUS-MARFIN_EGNATIA-GENIKI	2	_18	ALPHA-EMPORIKI-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	2
_12	PIRAEUS-MILLENIUM-MARFIN_EGANTIA	1	_19	EUROBANK-ATTICA	1
_13	PIRAEUS-MILLENIUM-ATE	2	_20	EUROBANK-AEGEAN	1
_14	PIRAEUS-MARFIN_EGANTIA-ATE	2	_21	EUROBANK-PANELLINIA	1
_15	PIRAEUS-ATE-GENIKI-MARFIN_EGANTIA	2	_22	EUROBANK-PANCRETAN	1
_16	PIRAEUS-ATE-GENIKI-MILLENIUM	2	_23	EUROBANK-PROTON-TT_HELLENIC-ATTICA	2
_17	PIRAEUS-GENIKI-MILLENIUM-MARFIN_EGNATIA	2	_24	EUROBANK-PROTON-TT_HELLENIC-AEGEAN	2
_18	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM	2	_25	EUROBANK-PROTON-TT_HELLENIC-PANELLINIA	2
			_26	EUROBANK-PROTON-TT_HELLENIC-PANCRETAN	1
			_27	EUROBANK-PROTON-TT_HELLENIC-ATTICA-AEGEAN	2
			_28	EUROBANK-PROTON_TT-HELLENIC-ATTICA-PANELLINIA	2
			_29	EUROBANK-PROTON-TT_HELLENIC-ATTICA-PANCRETAN	2
			_30	EUROBANK-PROTON-TT_HELLENIC-AEGEAN-PANELLINIA_2.LPJ	2
			_31	EUROBANK-PROTON-TT_HELLENIC-AEGEAN-PANCRETAN	2
			_32	EUROBANK-PROTON_TT-HELLENIC-PANELLINIA-PANCRETAN	2
			_33	EUROBANK-PROTON-TT_HELLENIC-ATTICA-AEGEAN-PANELLINIA	2
			_34	EUROBANK-PROTON-TT_HELLENIC-ATTICA-AEGEAN-PANCRETAN	2
			_35	EUROBANK-PROTON-TT_HELLENIC-ATTICA-PANELLINIA-PANCRETAN	2
			_36	EUROBANK-PROTON-TT_HELLENIC-AEGEAN-PANELLINIA-PANCRETAN	2
			_37	EUROBANK-PROTON-TT_HELLENIC-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	2

(Continued)

Table 2.14.b: Greece - Hypothetical M&As Scenarios (Continued)

	POTENTIAL - M&As	CLASS
_38	ETHNIKI-ATTICA	1
_39	ETHNIKI-AEGEAN	1
_40	ETHNIKI-PANELLINIA	1
_41	ETHNIKI-PANCREATAN	1
_42	ETHNIKI-FFB-PROBANK-ATTICA	1
_43	ETHNIKI-FFB-PROBANK-AEGEAN	2
_44	ETHNIKI-FFB-PROBANK-PANELLINIA	2
_45	ETHNIKI-FFB-PROBANK-PANCRETAN	1
_46	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN	2
_47	ETHNIKI-FFB-PROBANK-ATTICA-PANELLINIA	1
_48	ETHNIKI-FFB-PROBANK-ATTICA-PANCRETAN	1
_49	ETHNIKI-FFB-PROBANK-AEGEAN-PANELLINIA	2
_50	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	2
_51	ETHNIKI-FFB-PROBANK-PANELLINIA-PANCRETAN	1
_52	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN-PANELLINIA	2
_53	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN-PANCRETAN	2
_54	ETHNIKI-FFB-PROBANK-ATTICA-PANELLINIA-PANCRETAN	1
_55	ETHNIKI-FFB-PROBANK-AEGEAN-PANELLINIA-PANCRETAN	2
_56	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	2
_57	PIRAEUS-ATTICA	1
_58	PIRAEUS-AEGEAN	1
_59	PIRAEUS-PANELLINIA	1
_60	PIREAUS-PANCRETAN	1
_61	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA	2
_62	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-AEGEAN	2
_63	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-PANELLINIA	2
_64	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-PANCRETAN	2
_65	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA-AEGEAN	1
_66	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA-PANELLINIA	2
_67	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA-PANCRETAN	1
_68	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-AEGEAN-PANELLINIA	2
_69	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-AEGEAN-PANCRETAN	2
_70	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-PANELLINIA-PANCRETAN	2
_71	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA-AEGEAN-PANELLINIA	2
_72	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA-PANELLINIA-PANCRETAN	2
_73	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	2
_74	PIRAEUS-ATE-MARFIN_EGNATIA-MILLENIUM-GENIKI-AEGEAN-PANELLINIA-PANCRETAN	2
_75	ATTIKA-AEGEAN	2
_76	ATTICA-PANELLINIA	2
_77	ATTICA-PANCRETAN	2
_78	AEGEAN-PANELLINIA	2
_79	AEGEAN-PANCRETAN	1
_80	PANELLINIA-PANCRETAN	2
_81	ATTICA-AEGEAN-PANELLINIA	2
_82	ATTICA-AEGEAN-PANCRETAN	1
_83	AEGEAN-PANELLINIA-PANCRETAN	2
_84	ATTICA-AEGEAN-PANELLINIA-PANCRETAN	1

Notes: This table reports all the prospective scenarios of M&As among all the Greek financial institutions and the classification of the 'new' financial entity into the two latent technological classes according to the regime membership determinants described in Table 2.3.b.The first column presents two categories entitled 'Recent' and 'Recent (Potential)'. The former consists of all consolidation activities that took place recently and created the four so- called systemic banks (ALPHA, ETHNIKI, EUROBANK, PIRAEUS). As far as the latter is concerned it consists of all possible combinations of consolidation between the 'big four' of the Greek banking sector and the institutions that they finally were absorbed by them and altogether formed their systemic nature. We approach each one of these cases in both categories as a prospective M&A scenario in the economy, since our sample is dated up to 2011 and the recent consolidation wave took place in 2012 and 2013. The second column reports all possible combinations of consolidation between the four major banks of the Greek economy, before and after they got involved into the recent wave of M&As, and the four remaining banking institutions namely, Attica bank, Aegean bank, Panellinia bank and Pancretan. The table presents all possible combinations of consolidation among those four remaining banks (i.e. only non-systemic banks) and the classification of the new financial entity as well.

Chapter 3

Liquidity creation through efficient M&As. A viable solution for vulnerable banking systems? Evidence from a stress test under a PVAR methodology

3.1 Introduction

More than six years have passed since the beginning of the financial crisis in July 2007 but the economic impact it had on the real economy is still conspicuous. The crisis which began in the housing market of the USA in 2007 has since spread to the world financial system and the real economy. The crisis in the banking system climaxed in September 2008 and spread to Europe. Most economies experienced negative rates of growth, unemployment continues to increase, a number of financial giants have closed or are having severe problems, private consumption and investment have shrunk because of uncertainty and reductions in the value of financial assets. This crisis is different from previous ones, mainly because of its world-wide extent and because a vicious cycle links the problems in the financial sector with the deceleration of the real economy. The return to sustained growth presupposes, inter alia, restructuring of household portfolios, considered to be more difficult to occur than that of corporate portfolios. It is therefore difficult to establish mechanisms for coordination and return to positive growth rates.

The global financial turmoil was triggered by banks and as a result the banking sector was the first to confront the tremendous consequences of the crisis. The number of bank failures had escalated unparalleled. Bank stocks plummeted. One of the two central roles of banks [1] in the economy liquidity creation, was severely distorted. In response to both the great economic recession and the dire conditions of the banking industry, banks tightened their lending terms and standards to unprecedented levels. The tightening in bank lending could undermine or even derail the economic recovery.

That said, we turning now into the emerging importance of liquidity. Compared to credit risk, there is a smaller literature to discuss with liquidity risk. The Basel I Accord (Basel Committee on Banking

[1] The two central functions of banks are to transform risk and to supply liquidity to the economy.

Supervision, 1988) set out regulatory standards for credit risk. Besides, the Basel II Accord (Basel Committee on Banking Supervision, 2004) even takes operational risk into account. However, both of these accords seldom mention liquidity risk. Landskroner and Paroush (2008) also indicated that there has been an extensive academic and regulatory discussion of the different major banking risks: credit risk, market risk and even operation risk. However, relatively little attention has been paid to liquidity risk before the onset of the recent financial turmoil, that has become one of the major risks faced by banks and other financial institutions in recent years. Throughout the global financial crisis many banks struggled to maintain adequate liquidity. Unprecedented levels of liquidity support were required from central banks in order to sustain the financial system and even with such extensive support a number of banks failed, were forced into mergers or required resolution. The crisis illustrated how quickly and severely liquidity risks can crystallize and certain sources of funding can evaporate. Consequently, creating substantial liquidity buffers across the board is the explicit aim of a number of regulatory responses to the crisis, such as the Committee of European Banking Supervisors (CEBS) guidelines on liquidity buffers (CEBS 2009b) and the forthcoming Basel III liquidity standards, the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR).

The recent financial crisis underscored the importance of having a better understanding of the ways in which liquidity conditions influence credit extension to domestic and foreign customers. 5Bank liquidity came from abroad due to the incapability of domestic deposits to support the large expansion in credit growth. Nowadays, new liquidity is hard to come from abroad and and in addition there is a crying need in shifting demand from consumption to investment especially in countries where recession still follows an accelerating pace. However in periods of contracting economies investment opportunities are limited since the funding sources are scarce. For a loan expansion to occur domestic policy action is required, like reducing reserve requirements, capital increases in state-owned banks, increasing the minimum insurance on bank deposits, or coming to terms with the International Monetary Fund (IMF) mechanism. Nevertheless, investigation of different possibilities to increase the credit channels in the economy is of primordial concern for governments and policy authorities, especially in countries with a high level of sovereign debt and default risk.

In their influential paper Berger and Bouwman (2009), demonstrate that recently completed banks' M&As account for the industry's overall liquidity and show the greatest growth in liquidity creation over time. Additionally, a recent study by Pana et al. (2010) presents empirical evidence that banks with higher levels of deposit insurance create higher levels of liquidity around mergers. The theoretical basis on these findings lies in two strands of the literature. In the first strand, we refer to papers related to the banking theory of liquidity creation with respect to the sources of bank liquidity. In this category we find the seminal papers of Bryant (1980), Diamond and Dybvig (1983), Holmstrom and Tirole (1998), Diamond and Rajan (2000) and Kashyap et al. (2002). These authors explain that banks create liquidity both on balance sheet by financing relatively illiquid assets with relatively liquid liabilities and off balance sheet through loan commitments and similar claims to liquid funds. In the second strand, we refer to papers related to the dynamics and mechanisms that a consolidation activity generates with respect to liquidity creation and information. The primary contributions to this strand are the studies by Carletti et. al, (2007) and Panetta et. al, (2009). The insights that are revealed by the empirical evidence of both these papers is that consolidated banks create more liquidity as they take advantage of their improved ability to screen borrowers.

Our study differentiates itself from all the aforementioned ones, related either to M&As or to the liquidity creation framework, in that it adds insights in several respects, as discussed below. First and foremost we contribute to the literature by examining the concept of potential consolidation activity among banks and by addressing the question of whether it can lead to an increase of liquidity in the banking sector and consequently increase the credit channels in the economy, especially in countries with a high level of sovereign debt and severe country default risk. In this way, by conducting a comparative and a forecasting analysis pre-crisis and post-crisis, we exploit on one hand, potential social well-being benefits in the UK banking system through potential M&As and we address the question of whether they can reduce the scale of commitment to unconventional monetary activities (i.e QE, FLS) of the Bank of England. While on the other hand, we investigate whether potential M&As can be proved vital in alleviating the terms of the memorandum between Greece and the so-called Troika (IMF, European Commission, European Central Bank), enhancing the real economy, households and firms, with the creation of additional credit channels in the context of a severe contraction of the country's economic activity. In addition we shed light on the trade-off between managerial motives and social economic surplus that triggers M&A activity. This leads us to two the following prerequisites. The first raises concerns that a potential consolidation activity in the banking sector increases concentration in the system and it may cause anticompetitive effects with a negative impact to the social well-being. The second addresses the issue on how we will be able to measure liquidity with respect to potential bank'

M&As in the future. For this purpose, we propose the "Cost Efficiency - Liquidity Creation Hypothesis" (CELCH) to measure the liquidity creation of a potential bank consolidation activity through its potential level of efficiency. The CELCH argues that after a consolidation activity if the new financial institution has cost efficiency gains these can be reflected in both liquidity creation enhancement and social well-being surplus. Both the US and EU merger guidelines explicitly note that the criterion for judging potential mergers as acceptable is their ability to create merger-specific efficiency gains and pass them on to customers. Thus the CELCH has both theoretical and empirical foundations.

Nevertheless, the result of increased liquidity creation and social well-being via potential cost efficient bank M&As can lose its significance, if these outcomes vanish when adverse future economic conditions occur. In turn, to the best of our knowledge, it is the first study to address the impact of potential adverse economic conditions that can occur in an economy on liquidity creation and cost efficiency. To achieve that we create a stress test under a panel vector autoregressive (PVAR) methodology, where we shock two completely different banking systems in terms of "sophistication, market characteristics and volume of transactions", in three different ways; by imposing a macroeconomic, a financial and a bank specific shock. This is of extreme importance taking into account possible anticompetitive consequences that could result from a potential consolidation activity. In this way, we are able to extract inferences on the contribution of each specific prospective M&A to the robustness of each country's banking sector with respect to both liquidity creation and cost efficiency and consequently on whether it should be realised from both an economic and social perspective in the aftermath of the recent financial crisis. This leads to a third novelty of our study; via the PVAR framework we gauge and investigate the impact of efficiency on liquidity creation and the direction of causality among the two variables. Moreover, we are able to examine empirically the "Cost Efficiency - Liquidity Creation Hypothesis". An additional contribution of our study is the proposition of a novel methodology; i.e., to evaluate and compare the robustness of each potential bank M&As scenario through recent half-life measures (Chortareas and Kapetanios 2013). Further, it is the first study that examines all the historical UK and Greek banks' M&As with respect to their credit supply by employing recently developed measures of liquidity creation (Berger and Bouwman, 2009) that account for both on and off balance sheet banks' activities. Finally, for the first time in both banking sectors, the impact of the "Deposit Insurance Hypothesis" on liquidity creation is being analysed as well as the relationship between capital and liquidity which is expressed by two additional competing hypotheses: "Financial Fragility – Crowding out" vs. "Risk Absorption", in the spirit of Basel III, where a major emphasis on liquidity is given.

The empirical evidence that we present from the stress test scenario sets a solid foundation for our proposed "Cost Efficiency - Liquidity Creation Hypothesis" in two ways: first by the estimated positive impact of cost efficiency on liquidity creation and second by the fact that bank shocks and specifically the level of non-performing loans in the sector are the more persistent and account for most of the deviations of the forecasted values of both the cost efficiency and liquidity creation variables from their true levels. The causality between these two variables of interest is found to run stronger from liquidity creation towards cost efficiency than in reverse. Through the proposed CELCH, we provide evidence of increased liquidity that is created after potential M&A activity of two and three banking institutions in both the pre-crisis and post-crisis era, with considerably stronger evidence for the former period. In addition, in both periods the highest liquidity derived from potential consolidation activity is due to the large financial institutions. Doubts are cast on the decisions of the foregoing policy makers and the boards of the involving banks as far as the recent wave of bank consolidation and the creation of the so-called four 'cornerstones' of the Greek economy is concerned, with respect to social-benefits. Last but not least, we note that the impact of adverse macroeconomic and bank-specific conditions on the Greek banking sector's liquidity creation is greater in its current systemic formation rather than prior to the recent wave of M&As. This finding raises further questions about the social economic benefits of this recent wave of banks' consolidation activity.

The rest of the paper is organized as follows. Section 2 discusses the impact of the crisis and the bank consolidation developments in both UK and Greece while it reviews as well the relevant literature. Section 3 provides an overview of the theoretical framework and presents the recent measures of liquidity creation. Section 4 discusses our empirical methodology. Section 5, provides an overview of the main developments of each country within its respective sample period and describes the data. Section 6 presents the empirical evidence and robustness tests as well. Conclusions are quoted in section 7, while insights for future research are offered in the final section.

3.2 Financial and Sovereign turmoil - M&As

3.2.1 UK Financial Crisis

First we quote the UK' reaction mechanisms against the crisis, as the emergence of large, highly interconnected universal banks has transformed the financial network, increasing the likelihood of system-wide contagion in the event of an individual bank's distress. To the extent that these banks are 'too important to fail', private incentives are distorted and resources misallocated (Haldane, 2010). That said, a bank rescue package totalling some £500 billion in loans and guarantees was announced by the British government on 8 October 2008, as a response to the on-going global financial crisis. After two unsteady weeks at the end of September, the first week of October had seen major falls in the stock market and severe worries about the stability of British banks. The plan aimed to restore market confidence and help stabilise the British banking system, and provided for a range of short-term loans and guarantees of interbank lending, as well as up to £50 billion of state investment in the banks themselves. Most simply, £200 billion will be made available for short term loans through the Bank of England's Special Liquidity Scheme. Secondly, the Government will support British banks in their plan to increase their market capitalisation through the newly formed Bank Recapitalisation Fund, by £25 billion in the first instance with a further £25 billion to be called upon if needed. Thirdly, the Government will temporarily underwrite any eligible lending between British banks, giving a loan guarantee of around £250 billion. However, only £400 billion of this is 'fresh money', as there is already a system in place for short term loans up to the value of £100 billion.

The extent to which different banks participate will vary according to their needs. HSBC Group issued a statement announcing it was injecting £750m of capital into the UK bank and therefore has "no plans to utilise the UK government's recapitalisation initiative". Standard Chartered also declared its support for the scheme but its intention not to participate in the capital injection element. Barclays intends to raise £6.5 billion from private investors, and will cancel its final dividend for the year for a net saving of £2 billion. The Royal Bank of Scotland Group will raise £20 billion from the Bank Recapitalisation Fund, with £5 billion in preference shares and a further £15 billion being issued as ordinary shares. HBOS and Lloyds TSB will together raise £17 billion, £8.5 billion in preference shares and a further £8.5 billion issue of ordinary shares. The Fund will purchase the preference shares outright, for a total £13.5 billion investment, and will underwrite the issues of ordinary shares; should they not be taken up by private investors, the Fund will undertake to purchase them. If none of the new stock is taken up, this would give the Government an overall holding of 60% of the Royal Bank of Scotland, with 40% of the merged HBOS-Lloyds, held as a mixture of preference and ordinary stock.

A second bank rescue package totalling at least £50 billion was announced by the British government on 19 January 2009, as a response to the on-going global financial crisis. The package was designed to increase the amount of money that banks could lend to businesses and private individuals. This aid comes in two parts: an initial £50 billion being made available to big corporate borrowers, and a second undisclosed amount that forms a form of insurance against banks suffering big losses.

3.2.2 UK Sovereign Crisis

The Bank of England (BoE) has operated, since January 2009, an Asset Purchase Facility (APF) to buy "high-quality assets financed by the issue of Treasury bills and the DMO's cash management operations" and thereby improve liquidity in the credit markets. It has, since March 2009, also provided the mechanism by which the Bank's policy of "Quantitative Easing" (QE) is achieved, under the auspices of the Monetary Policy Committee (MPC). In July 2012, the MPC announced the purchase of a further £50bn to bring total assets purchases through the Asset Purchasing Facility (APF) to £375 bn. The APF is undertaken by a subsidiary company of the Bank of England, the Bank of England Asset Purchase Facility Fund Limited (BEAPFF). The same month the Bank of England and the HM Treasury launched the "Funding for Lending Scheme" (FLS). The FLS is designed to incentivise banks and building societies to boost their lending to the UK real economy. It does this by providing funding to banks and building societies for an extended period, with both the price and quantity of funding provided linked to their lending performance. Nevertheless, despite the £14bn that have been provided via the FLS, it was revealed that the total lending was actually less in the six-month period after FLS's implementation than in the six-month period before. In the summer 2013, the new governor of the BoE, Mark Carney, has set out a "forward guidance" policy in a way of converting low short-term interest rates into lower long-term interest rates, in order to try to make the unconventional monetary policy; QE and FLS, more effective. Nonetheless, the annual rate of growth in the stock of lending to UK businesses in both large and small enterprises was negative while the annual rate of growth in the stock of secured lending to individuals remain unchanged, (BoE October 2013).

Figure 3.1.a diplays the annual growth rate of the volume of credit facility (i.e. loans) provided in both public and private sector by the financial intermediaries operating in the UK. We note that the highest positive annual percentage changes take place in the years 1995, and 2005. In both of these years, the UK experienced the biggest wave of M&As that took place in the domestic banking sector. Additionally,

we note the ample credit facility in the year 2009 and its adverse consequencesin the two following years, indicated by the negative values of the annual percentage change which characterises the onset of the recession period that UK follows thereafter.

3.2.3 Greek sovereign debt crisis in the context of the banking sector

The collapse of Lehman Brothers affected the confidence of depositors and forced the European governments to take action in providing additional liquidity aid by the Eurosystem. It is noteworthy that Greek banks were not exposed to the risks that triggered the recent global financial crisis. Thus, the spillover effects from the global financial crisis on the Greek banking system were limited. Accordingly, there was no need to activate a bank rescue programme. Hence, the recovery plan adopted by the Greek government in late 2008 was mainly aimed at the enhancement of liquidity conditions in the system. Following its European counterparties as far as the deposit insurance schemes are concerned regarding the first policy initiatives against the crisis, Greece established in 2008 the Hellenic Deposit and Investment Guarantee Fund (HDIGF), which raised the maximum deposit guarantee cover per depositor from €20,000 to €100,000.[2]. In October 2008 the Greek government had announced a €28bn support package for Greek banks consisting of €5bn of capital injections as far as a recapitalization scheme was concerned, €15bn of state loan guarantees to credit institutions with varying maturity from three months up to three years in order for the banking system to meet its liquidity needs and €8bn of

[2] The Hellenic Deposit Guarantee Fund (HDGF) existed from 1995 till then.

liquidity in the form of special bonds with maturity up to three years to be used as collateral to the Eurosystem and/or the interbank market for any credit provided by them. Greece's largest banks opted to participate in the capital-raising scheme, designed to bring their Tier 1 capital ratios above 8.5%. By June 2009, around 80% of the available state-supported capital injections were taken up by the banks, but then they asked for the remaining €17bn of €28bn in the following April.

As was expected, during the global financial crisis, liquidity conditions have deteriorated as Greek banks had limited access to wholesale markets to fund their lending activity, and maturing inter-bank liabilities put additional pressure on their liquidity position. Despite the problems, Greek banks have shown remarkable resilience and were able to refinance their loan portfolios owing, *inter alia*, to a number of factors: they had a strong capital base and steadily increased their provisions (more than 40 per cent, year-on-year);they were facilitated by measures taken by the European Central Bank and the Greek government and the effective prudential supervision by the Bank of Greece ensured the stability of the Greek banking system. Overall, during the global financial crisis, the Greek banking system remained healthy, adequately capitalised, and highly profitable.

The Greek banking system was negatively affected by the Greek debt crisis. The recession and losses from government debt exposures have had considerable implications on the banking system, undermining the financial stability of the previous years. As a result Greek banks lost access to the international wholesale market in early 2010 because of increasing perceived risks stemming from the fiscal crisis and the downgrading of Greek government debt to junk bond status in April 2010. As a result, they have relied almost exclusively on the E.C.B for funding, using government and other bonds as collateral. In May

2010, the Eurozone countries and the International Monetary Fund (IMF) agreed on a €110 billion bailout loan for Greece (i.e., the first Memorandum).

A number of steps have been taken to stabilise the Greek banking sector. First, the E.C.B decided in early May 2010 to waive Greece's minimum sovereign rating requirement to draw funds, ensuring that Greek banks will not be cut off from the emergency lending facility. Second, a new aid package for banks under the IMF/euro zone programme reinforces stability in the banking sector in the medium term. The package consists of an additional €15bn in loan guarantees offered by the Greek government as part of its support package, bringing the total amount of state-afforded liquidity up from €28bn to €43bn. Third, by the end of June 2010 the European Financial Stability Fund (EFSF) was created along with the national branch, the Hellenic Financial Stability Fund (HFSF), consisting of a €10bn loan from the IMF/euro zone to be used to provide capital injections. Overall in 2010 Greek banks drew a total of €97bn of liquidity from the E.C.B.

Nevertheless, one year later Greece is still in serious danger of running out of cash and defaulting on its debt. The latter enforces the urgent need to find new sources of liquidity as it is globally highlighted in various articles (see Katie Martin, June 1 2011, Wall Street Journal) and is noted that the basic problem of Greek banks is not capital but liquidity (June 7 2011, Reuters). The European Central Bank (E.C.B) is the only source of lending for Greek banks. The banks complain that the E.C.B. is pressuring them to reduce their dependence on central bank funding, hurting not only the banks but Greek businesses and consumers who are unable to get credit. (June 21 2011, New York Times). In October 2011, Eurozone leaders consequently agreed to offer a second €130 billion bailout loan for Greece (i.e., the second Memorandum), conditional not only on the implementation of another austerity package (combined with the continued demands for privatisation and structural reforms outlined in the first programme), but also that all private creditors holding Greek government bonds should sign a deal accepting lower interest rates and a 53.5 per cent face value loss. The second bailout deal was finally ratified by all parties in February 2012, and became active one month later.

Private Sector Involvement (PSI)

All the aforementioned led us to March 2012 when, the new rescue plan for Greece was signed in Brussels and accepted by private investors. It combines "new money" (130 billion from the EU and the IMF) with "debt reconstruction". Private holders of the 177 billion Greek debt issued under Greek law (out of 206 billion of private debt) will take a 53.5 per cent haircut on the debt's nominal value, with the remaining 46.5 per cent will be swapped for cash (15 per cent) and for new longer term Greek debt (31.5 per cent), with an estimated present value cut of 75 per cent. Yet, as pointed out by some observers (Roubini, 2012), the direct Official Sector Involvement is also going to be considerable: the estimated 100 billion of total debt relief imposed on private creditors will be partly offset by the new 130 billion official money, which will go largely to private investors (15 billion in the European Financial Stability Fund (EFSF) guarantees and about 30 billion for banks recapitalization). In addition, a positive result that emanates from the PSI was the upgrade of Greek economy from RD status (restricted default) to B- status, by one of the three largest rating agencies (Fitch). Nevertheless, the status B- which applies to the new bonds issued under Greek law, is still junk status, meaning they are not yet in an investment grade despite the huge cut to Greece's debt pile. However, the upgrade of the Greek economy boosts the confidence of E.C.B, who upgrades the collateral supplied to them by Greek banks. It is expected that this will immediately lead to an extra 25 billion euros of liquidity being available to lenders in Greece.

Nevertheless, Greece has seen a slow run on its banks, as companies and increasingly ordinary Greeks take their money out in cash, or move it to the safety of a bank account abroad. So the problem is not just that money has stopped flowing into Greece, but that is actually flowing out of the country, and that makes it even harder for the Greek banking system to fulfil its basic function of supporting the Greek economy. In turn, Greece is in a deep economic slump since banks aren't lending and consequently companies aren't investing. The latter enforces the urgent need to find new sources of liquidity in the Greek banking market.

The Greek turnaround is nowhere more evident than in the banking system. Prior to the crisis, the banking sector was highly competitive by international standards, with sound fundamentals. But the sovereign crisis put the sector under stress as banks experienced substantial deposit outflows, became cut off from capital markets, and took sharp losses on Greek sovereign bonds. The banks responded by deleveraging, a process that itself contributed to economic contraction and created negative feedback loops between the financial and real sector. Under these circumstances, the stability of the Greek banking system could have been at risk, with possible implications beyond Greece. A leaner, restructured Greek banking sector was needed, which is something difficult to achieve in the best of times but especially difficult amid a contracting economy.

Systemic era

That said, in the second half of 2012 up to the third quarter of 2013, the Greek banking sector experienced a complete turnaround, where eleven banks where merged or absorbed to form the 'new' four systemic cornerstones (i.e., Alpha bank, Eurobank, National Bank of Greece or Ethiki bank, Piraeus bank) of the country's economic recovery. For this purpose a recapitalization programme of the banking sector totalling €50bn was initiated by the EFSF via the HFSF. Moreover, those four systemic banks raised nearly €30bn in equity and regulatory capital. The result was that three of the new systemic banks managed to raise the 10 per cent capital they needed to avoid nationalisation, apart from Eurobank.

Nevertheless, despite the aforementioned actions, there is increasing speculations among the supranational institutions of a new 'haircut' and another reconstruction of the Greek debt in 2014, since projections cast doubts that the target set by the Troika of 120 per cent of debt to GDP ratio by the end of 2020 becomes unrealistic. With this in mind uncertainty came back to the markets, where for the first time after the Euro era, Greece is downgraded by an 'index' (i.e. S&P Dow Jones) from developed to emerging market in the end of October 2013. Finally, according to the report of the Governor of the Bank of Greece (October 2013), there is a negative 3.9% annual change in the 'total level of credit' provided by the Greek financial intermediaries to both public and private sector at the same time when Greek 'bank deposits' have experienced a positive 6.7% annual change. In addition the sector's interest rate spread met an annual increase of 3.6%. Consequently, further concerns are raised regarding the effectiveness and the social surplus of the recent wave of consolidation in terms of 'credit' and 'liquidity' provided in the economy which is a neuralgic prerequisite for the promotion of investments and growth.

Figure 3.1.b, illustrates graphically the annual growth rate of the volume of credit facility (i.e. loans) provided in both public and private sector by the financial intermediaries operating in Greece up to 2011. We notice the highest positive percentage change in the year 2000, which is one year after the big wave of M&As that took place in the domestic banking sector and as before (i.e, UK bannking system) it might give a signal of a positive relationship between M&A activity and liquidity provided one year after. As in the case of the UK banking sector, with a time lag though, it's unequivocally clear that there was an unprecedented decline in credit provided by the Greek financial intermediaries once the consequences of the crisis started to become apparent in the economy.

3.2.4 Mergers and Acquisitions

Merger and acquisition (M&A) deals are the two most visible expressions of the functioning of the corporate control market. While M&A refer to different deals, these are usually analysed together since both achieve the same goal, which is the change of ownership of a company. In turn, M&As are a very important phenomenon not only because they are associated with deals that reflect a significant monetary value, but due to the fact as well that they refer to the change of corporate control and the formation of the structure of the market. The consolidation in the banking industry has been an important phenomenon worldwide. In the last two decades banking systems have displayed very high rates of consolidation via mergers and acquisitions (M&As) among different countries and regulatory environments around the world. The main causes for this unprecedented wave of M&As, which are common to most countries, are the deregulation and integration of financial markets as well as technological innovations and the development of new IT systems. With this in mind, one of the main reasons for M&As is to increase bank efficiency via effective operational synergies. Whether these synergies can be generated via bank M&As depends on the realization of economies of scale and scope. Economies of scale may arise because consolidated banks may achieve control of cost-saving technologies or spread their fixed cost over a larger volume of output, thus reducing average cost and increasing efficiency. Economies of scope may arise because merging banks enter new markets and cross-sell their products to existing customers. In addition to any effects of operational synergies per se, as the study by Haynes and Thompson (1999) indicates, bank M&As may have a potential impact on bank performance via one of the three following ways: first, via the selective redeployment of assets, i.e. horizontal mergers could generate savings as output is reassigned to more productive capital (Dutz, 1989); second, via the transfer of asset control to better quality managers (Thompson, 1997); and third, via the renegotiation of implicit labour contracts (Shleifer and Summers, 1988). However, the extent to which the aforementioned gains could be exploited via bank M&As might be elusive in large, complex institutions.

The banking literature (e.g. Vander Vennet, 1996; Resti, 1998; Amel et al., 2004) provides three additional motives for bank M&As which are not justified on efficiency grounds. The first is related to the management-utility maximization hypothesis and the other two are related to the too-big-to fail (TBTF) and the market power arguments. With regard to the management-utility maximization hypothesis, managers channel expenditures based on their private preferences and for this reason they might seek to increase the size of their institutions via M&As so as to increase their perquisites, prestige, power and salary levels. Furthermore, as the size of the bank increases the TBTF argument comes into effect because the concern about the demise of a particular bank increases as the size of that bank increases. The third argument indicates that banks via M&As aim to obtain market power in order to exploit quasi-monopoly profits. According to Vander Vennet (1994) the market power motive of M&As can better characterize EU banks because they are organized as a system of national oligopolies. Thus, consolidation may increase the market power of EU banks and strengthen their competitive position on their home markets.

Nevertheless, despite their popularity, many of the M&As fail to deliver the expected outcomes. This could either reflect the complexity of these deals or that many of them are related to managerial purposes rather than to the maximization of shareholders' wealth. The impact of bank mergers in the banking industry has raised concerns from a different perspective in addition to the one developed above (i.e., the social welfare). Policy-makers remain sceptical as to whether bank borrowers can benefit from the consolidations. The consequences of bank M&As on the welfare of borrowers have been investigated from two perspectives: credit availability and loan pricing behaviour. Banks have an essential role in the economy. One of their main duties is to collect funds from excess fund sectors and lend to customers with insufficient funds. From these financial intermediary activities, they have an important role in determining the amount and distribution of credit in the economy. Since an increase in bank credit leads to increased investment and in turn to increased employment levels, changes in bank lending behaviour have a marked impact on the economic development of the country. Banks change their lending decisions in response to changes in the structure of the banking market. One of the issues arising in this context is bank mergers and acquisition (M&As). Since market structures can change as a result of mergers, bank mergers can have a significant impact on changes in bank lending behaviour, especially when a country confronts an overall meltdown of its economic activity.

UK M&As

The UK banking sector experienced an unprecedented reform in 1986 with the so called 'Big Bang'. The changes saw many of the old firms being taken over by large banks both foreign and domestic and would lead in the following years to further changes to the regulatory environment that would eventually lead to the creation of the financial services authority (FSA). The effects of Big Bang were dramatic, with London's place as a financial capital decisively strengthened, to the point where it is arguably the world's most important financial centre. According to the UK legal framework, mergers between banks can be blocked when they are viewed to limit competition. Central to improving the competitiveness of a sector is both the achievement of efficiency or synergies from the mergers and the degree to which these efficiency savings will be passed on to customers. For example, a recent large UK bank merger between Lloyds TSB and Abbey National was expected to create substantial efficiency gains. This merger was blocked as the competition authority stated, amongst other reasons, that these efficiency gains would not be passed on to customers (Competition Commission 2001). This decision, emphasising the pass through of efficiency gains to customers over the realisation of efficiency gains alone, is consistent with the social equity and/or consumer welfare concerns which underpin competition law within Europe and the

USA (Stuyck 2005). The Treasury Committee in October 2012 recommended the government "include an explicit requirement for the Prudential Regulatory Authority to approve major bank acquisitions and mergers in forthcoming legislation". Recent speculations conjectured that potential bidders are interested to buy Lloyds' shares from the government. The relatively concentrated UK banking market, with a limited number of large banks and a large fringe of smaller banks, has appreciated a considerable amount of merger activity during the previous decades consisting of both banks and building societies. Table 3.1.a, highlights the merging and acquisition activity that took place in the UK the last two and half decades.

Greek M&As - Pre Crisis

The main factors behind the M&A activity in the Greek banking sector during the second half of the 1990s were the country's forthcoming accession into the Economic and Monetary Union (EMU) and the possible decrease in income this would cause, stronger competition in the domestic market and potential competition from foreign banks and the introduction and advancement of new technology. It's noteworthy that during 90's the strand on the Greek banking market was a big wave of privatizations and acquisitions of banks that where either directly or indirectly under state control (e.g. acquisition of Macedonia-Thrace bank and Hellenic Industrial Development Bank by Piraeus bank and acquisition of Ionian bank by Alpha bank). An acquisition that caused a stir in the market was that of Ergobank by Eurobank (1999). Another noteworthy fact is that after 2004, there has been a big wave of acquisitions of Greek banks by foreign banks, mostly French ones (e.g. acquisition of Geniki bank by Societe Generale and Commercial bank(former Emporiki) by Credit Agricole. On the whole the vast majority of the M&As in the Greek banking sector were completed by the large banks before the end of the Millenium and represented more than 33% of the value of the asset side of the whole sector. In general Greek banks did not pursue any M&A activity in the EURO -area but mostly in the Balkan and south Eastern European region. The result of all M&As that took place in the last two decades is the creation of six dominant banking groups in Greece, namely National bank of Greece, EFG Eurobank, Alpha bank, Piraeus bank, Commercial bank and Agricultural bank. With this in mind, before the onset of the financial crisis markets expected further M&A activity by the six major banks targeting smaller banks. Nevertheless, no one could be certain whether there would be any further activity. Additionally, economic theory suggested that M&As would continue mostly among small banks, since figures revealed that small Greek banks operated under a 10% of return on equity (ROE) and with a 70% cost to revenue ratio, in a period when the same average figures for the European counterparties were 20% and 50% respectively. In turn it seemed that this category of banks has not reached yet the size that will enable them to perform like their large competitors did.

Greek M&As - Post Crisis

That said, there was increasing speculation in Greece about the possibility of mergers between banks, in order to give them greater clout in raising wholesale resources. In April 2010 Hellenic Postbank acquired a 32.9% stake in Aspis Bank. Hellenic Postbank is owned 34.4% directly by the government and 10% by Hellenic Post, which is completely owned by the Greek government. There have been rumours of

Hellenic Postbank merging with NBG as part of a politically backed effort to create "one strong state bank and two to three private banks", in the words of the prime minister, George Papandreou, in an interview in September 2010. Piraeus Bank proposed in 2010 a plan for merging with the financially strong Hellenic Postbank and ATE bank, which is problematic, yet rich in illiquid assets. The proposal was declined. National Bank of Greece submitted a proposal to Alpha Bank for a friendly merger on February 2011. The board of Alpha bank rejected unanimously that proposal[3]. Lastly, Greece's second and third largest lenders Eurobank and Alpha bank on August 2011, rubber-stamped the deal to form the largest bank in southeast Europe, aided by a capital injection from the Qatar Investment Authority and the 23rd largest bank in Europe.The deal collapsed on March 2012 after the private sector's involvement (PSI) in debt reconstruction. Nevertheless, recent announcement of Basel III Accord (Basel Committee on Banking Supervision, 2010) rules on capital requirements and liquidity, which are intended to shore up the international banking system against further shocks, and pressures to Greek banks, by the so-called "troika" (European Union, International Monetary Fund and European Central Bank) to align with the principles of Basel III , create an expectation for further consolidation in the Greek banking sector in the recent future.

The last round of domestic banking consolidation in the post crisis area was inaugurated by Piraeus Bank acquiring the sound part of ATEbank in late July 2012. At that time, few had thought that development was not an exceptional case, but it was actually the first in a series of upcoming M&A transactions: In early October National Bank

[3] About a decade ago the same two banks tried to merge but the plan fell apart because corporate culture was very different and there were disputes over management roles between the two senior executive teams

announced a tender offer to Eurobank shareholders creating the largest (by far) Greek banking group. A couple of weeks later on October 17, Alpha Bank announced it had entered into a contract with Credit Agricole for the acquisition of its Greek subsidiary, Emporiki Bank. Before the end of 2013, eleven banks were deleted from the 'new' Greek banking sector and four systemic banks were created, the so-called four cornerstones of the Greek Economic recovery. Table 3.1.b displays all the pre and post crisis M&As in the country.

3.2.5 Related Literature Review

UK and Greek M&As

In the literature in both countries only a handful of studies have examined banks' consolidation activity[4]. As far as the UK banking sector is concerned, the first study to date is by Barnes (1985) where he tested the hypothesis that merger benefits will arise in terms of improved management expenses ratios and growth rates. In terms of the former, this does not seem to be borne out either in the short period or the long period. The tendency in fact was towards higher operating unit costs. The evidence for increased growth rates as a result of merger is not conclusive. He notes that undeniably , a merger has effects on the future performance and policy of a society; these may however, be qualitative rather than quantitative, and aggregate performance may be unaffected. Haynes and Thompson (1999) empirically investigated the impact of acquisition activity on financial intermediary productivity. Specifically, they used an augmented production function approach

[4] We exclude cross-country studies and we focus only on surveys where UK and Greece individually are the countries of attention.

to investigate the impact of acquisition, after controls for input changes. Their model is estimated on an unbalanced panel of UK building societies over the period 1981–1993, using data on their core financial intermediation activities. Their results indicate significant and substantial productivity gains following acquisition. These were consistent with an acquisitions process in which less efficient firms are acquired and reorganized. The post-merger gains appeared to increase substantially in the post-deregulation period, when pressures to minimize cost are widely considered to have increased. In more recent years, Ashton and Pham (2007) examined the influence of bank mergers by focusing on the level of interest payable on retail deposits. Using data from the UK retail bank mergers between 1988 and 2004, their results indicate that merged banks tend to be more cost efficient, which leads to improved deposit interest rates for their consumers. The last study we found in the literature is by Ashton (2012) where he examined whether depositors benefit from bank mergers and whether horizontal retail bank mergers influence the availability and interest rates of deposit services. The author reports that different deposit services and deposits of different values face statistically insignificant levels of interest-rate change after mergers. The availability of notice deposit services for low and high levels of investment is reduced after mergers and is largely unchanged for other deposit services. He concludes that UK depositors benefit little from bank mergers, and different types of depositors face differences in the availability of deposit services after mergers.

Turning to the Greek banking sector, the first study that addressed the phenomenon of M&As is by Athanasoglou and Brissimis (2004) which examined the effect of M&As in Greek banking on the cost and profit efficiency and on economies of scale by using financial indicators. The results of this study show an improvement in cost and, in particular, profit efficiency between the pre-merger period (1994–1997) and the post-merger one (2000–2002).With regard to economies of scale, the study indicates that the post-merger period is characterized by the presence of economies of scale throughout the whole size range of Greek banks as opposed to the pre-merger period where economies of scale were found only in small to medium-sized banks, with large banks experiencing negative economies of scale. Then we find the paper of Halkos and Salamouris (2004) where they measured the performance of Greek banks during the first wave of M&As (i.e., 1997-1999). The authors report mixed evidence for the impact of M&As on efficiency. The third study is conducted by Mylonidis and Kelnikola (2005) which used financial indicators to investigate whether profit, operating efficiency and labour productivity ratios improved after the mergers of the period 1999–2000. Their results indicate that the aforementioned financial ratios did not improve but when compared with the corresponding ratios of non-merging banks the result show those mergers had a positive impact on performance. Rezitis (2008) finds that M&As exercise a negative impact on bank technical efficiency and total factor productivity growth during the 1993-2004 period. Pasiouras and Zopounidis (2008) examined the relationship between banks' performance and the likelihood of acquisition in the Greek banking industry over the period 1998-2002. The authors conclude that profitability, expenses management, liquidity, the annual growth of banks' total assets and capital strength do not seem to have an impact on acquisition likelihood. Additionally, they note that the number of branches, the size of banks and the market share are negatively related to acquisition likelihood, proving support that achievement of greater market share in the market was the main reason for large banks to acquire smaller institutions. In the same year, using a sample over the period 1997-2007, Vergos and Christopoulos (2008) found that cumulative abnormal returns are positive when the target is a Greek bank, but negative when the target is a foreign bank. Siriopoulos and Tziogkidis (2010) argued that one should examine M&As while accounting for other significant events like privatizations, regime changes, market crisis, etc. By examining the period 1993-2005 they find that after significant events the efficiency of Greek banks declines, while a recovery period follows, leading to a greater efficiency score compared with the initial state within the next two to three years. Finally, Liargovas and Repousis (2011) follow both an event study approach and an operational performance approach for the period 1996-2009. The results indicate that bank mergers and acquisitions have no impact and do not create wealth. Additionally, the authors note that operational performance measured by financial ratios does not improve after M&As.

Liquidity Creation

"Liquidity creation" refers to the fact that banks provide illiquid loans to borrowers while giving depositors the ability to withdraw funds at par value at a moment's notice (e.g., Bryant, 1980; Diamond and Dybvig, 1983). Banks also provide borrowers liquidity off the balance sheet through loan commitments and similar claims to liquid funds (e.g., Boot, Greenbaum, and Thakor, 1993; Holmstrom and Tirole, 1998; Kashyap, Rajan, and Stein, 2002; Thakor, 2005).

Standard textbooks on financial intermediation (e.g., Greenbaum and Thakor, 2007; Freixas and Rochet, 2008) explain that banks are institutions that make loans funded by a combination of deposits from the public and equity supplied by the banks' shareholders. More formally, banks engage in "liquidity creation," which is a form of "qualitative asset transformation". As explained in Bouwman (2013), to understand liquidity creation, we can picture a firm in need of long-term financing in a world without banks. In such a world, savers would directly finance the funding needs of the firm, and they would end up with an illiquid claim against the firm. In contrast, in a world with banks, it is the bank that provides the long-term loan to the firm, and the bank is able to offer savers demand deposits. So it is the bank that holds the illiquid claim against the firm and savers end up with a liquid claim against the bank. Because of this difference in liquidity between what banks do with their money and the way they finance their activities, banks are said to create liquidity.

The literature on banks' liquidity creation remains scarce because its expansion is a recent development in the wake of Berger and Bouwman's (2009) pioneering article. Their paper makes a major contribution by suggesting a new method for measuring the liquidity created by banks. The authors use this method to measure liquidity creation in the US banking industry between 1993 and 2003. They find that liquidity creation increased substantially between 1993 and 2003, as the US banking industry created $2.8 trillion in liquidity in 2003. They find that the relation between capital and liquidity creation varies with size and depending on whether off-balance-sheet items are added to the liquidity creation measure. With measures that include off-balance-sheet items, the relation is positive for large banks, not significant for medium banks, and negative for small banks. With measures excluding off-balance-sheet items, the relation is not significant for large and medium banks, and negative for small banks. Then Fungáčová et al. (2010) extend the debate by analysing how a deposit insurance scheme affects this relation. The authors study Russia since it provides a natural experiment to investigate this issue because a deposit insurance scheme was implemented there in 2004. A negative relation between capital and liquidity creation is reported before and after the deposit insurance scheme. Additionally, they observed that the relation varies with size and ownership. Their results indicate a statistically significant negative relationship for small and medium banks and for private domestic banks, while the relation is not significant for large banks, foreign banks, and state-owned banks. Further, Pana et al. (2010) examine the impact of bank mergers on liquidity creation for US banks, reporting a positive influence of mergers on banks' liquidity creation. Rauch et al. (2011) examine potential determinants of liquidity creation for a sample of German savings banks. By comparing the influence of macroeconomic factors, including monetary policy and unemployment, with bank-specific factors such as size or financial performance, they find some support for the impact of monetary policy; the tightening of monetary policy reduces liquidity creation. However, bank-specific factors do not seem to have any influence on liquidity creation.

Berger and Bouwman (2012) analyse the impact of monetary policy on aggregate liquidity creation by banks in the US. Analysing the period from 1984 to 2008, they examine whether the impact differs between normal periods and financial crises, and whether the impact also differs according to bank size. Their empirical evidence indicates that tightening monetary policy only reduces liquidity creation for small banks. This effect is weaker during financial crises. They also note that liquidity creation is somewhat higher prior to financial crises that suggests measures of aggregate liquidity creation have explanatory power in predicting crises. While Berger et al. (2012) investigate how regulatory interventions and capital injections influence risk and liquidity creation using a sample of German universal banks. The authors find that these interventions reduce both risk and liquidity creation. Fungacova et al.

(2013) investigate bank failures related to the core liquidity-creating role of bank. They introduced a novel hypothesis; the "Excessive Liquidity Creation Hypothesis" (ELCH), where according to it a rise in a bank's core liquidity creation activity increases its probability of failure. The results suggest that excessive liquidity creation significantly increases the probability of bank failure that regulatory authorities can mitigate systemic distress and reduce the costs to society from bank failures through early identification of excessive liquidity creators and enhanced monitoring of their activities. Horvath et al. (2013), investigate the relation between capital and liquidity creation by banks by examining the causality of this link. They show a negative, bi-causal relation between capital and liquidity creation, where capital negatively Granger-causes liquidity creation for small banks and that liquidity creation Granger-causes a reduction in capital. The same authors (Horvath et al., 2013) examine the relationship between bank competition and liquidity creation by banks and found that increased bank competition reduces liquidity creation. They conclude that competition increases bank fragility, which reduces banks' incentives to create liquidity. A similar study was conducted by Joh and Kim (2013), who investigate the relationship between competition and liquidity creation in the banking industry among twenty five OECD countries. Their empirical evidence suggests that as the market becomes less competitive, a bank provides more liquidity to customers. Additionally, they find large banks to increase their loan supply and liquidity creation as the banking industry becomes more concentrated while statistically significant changes in their liquidity supply are found for the small banks regardless of their market structure.

Our study differentiates itself from all the aforementioned ones, related either to the M&As or to the liquidity creation framework, in that it adds insights in several respects, as discussed below. First and foremost we contribute to the literature by examining the concept of potential consolidation activity and by addressing the question of whether it could lead to an increase of liquidity in the banking sector and consequently to the creation of new credit channels in the economy. In this way, we are able to exploit on one hand, potential social welfare benefits in the UK banking system through potential M&As and we address the question of whether they can reduce the unconventional monetary activities (i.e QE, FLS) of the Bank of England. While on the other hand, we investigate whether potential M&As can be proved vital in alleviating the terms of the memorandum between Greece and the so-called Troika (IMF, European Commission, European Central Bank), enhancing the real economy, households and firms, with the creation of additional credit channels in the spectrum of a severe country default risk. In addition, we employ a comparative and a forecasting analysis pre-crisis and post-crisis, where we shed light on the trade-off between managerial motives and social welfare that triggers M&A activity. We establish the effects on liquidity creation of potential consolidation activity via our proposed hypothesis, "Cost Efficiency-Liquidity Creation Hypothesis" (CELCH), which argues that enhancing in terms of "cost efficiency" banks' M&A, can create both increased liquidity and social well-being surplus. Second, to the best of our knowledge, it is the first study to address the impact of potential adverse macroeconomic, financial and bank-specific conditions that can occur in an economy on liquidity creation and cost efficiency. For this purpose we create a stress test scenario under a panel vector autoregressive (PVAR) model. In this way we are able to extract unbiased inferences regarding the robustness of a banking sector with respect to both its liquidity creation and cost efficiency level and extract thusly crucial policy implications towards the stability of vulnerable banking systems especially in the era of the recent financial crisis and towards the spectrum of the economic prosperity. This leads to a third novelty of our study, where we gauge the impact of efficiency on liquidity creation and the direction of causality among them in two completely different in terms of "sophistication, market characteristics and volume of transactions" banking systems, the UK and the Greek one. An additional contribution of our study is the proposition of a novel methodology; i.e. the concept of half - life, to evaluate and compare the robustness of mergers and acquisitions. Moreover, is it the first study that examines all the historical UK and Greek banks' M&As in respect to their credit supply by employing recently developed measures of liquidity creation (Berger and Bouwman, 2009) that account for both on and off balance sheet banks' activities. Finally, for the first time in both banking sectors, it is being analysed the impact of the "Deposit Insurance Hypothesis" on liquidity creation and the relationship between capital and liquidity which is expressed by two additional competing hypotheses: "Financial Fragility – Crowding out" vs "Risk Absorption", in the spirit of Basel III, where a major emphasis on liquidity is given and it is implemented by the introduction of two ratios, namely the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR).

3.3 Theoretical Framework

According to the theory of financial intermediation, an important role of banks in the economy is to provide liquidity and specifically better liquidity insurance than financial markets. On one hand, banks can create liquidity through their on-balance sheet activities by funding long term illiquid assets (e.g., business loans) with short term liquid liabilities (e.g., transactions deposits) (Bryant, 1980; Diamond and Dybvig 1983). To put it differently, banks can be liquidity providers, as they hold illiquid assets and provide cash and demand deposits to the rest of the economy. On the other hand, banks can enhance their liquidity provision via off-balance sheet activities, through loan commitments and claims to liquid funds because the feature of loan commitments is very similar to demand deposits from the perspective of customers (Holmstrom and Tirole, 1998; Kashyap et al., 2002). On the contrary, liquidity can be destroyed when banks use illiquid liabilities or equity to finance liquid assets (e.g treasury securities). Consequently, they expose themselves to the risk of facing a sudden increase in deposit withdrawals, and thus to the risk of a bank run.

In periods of crisis, Diamond and Dybvig (1983) and Allen and Santomero (1998) argue that liquidity creation increases the probability of higher losses when illiquid assets are sold to meet a sudden increase in customers' liquidity demands. Nevertheless, Carletti at al. (2007) argue that this risk is partially mitigated through a bank merger. The authors note argue that banks' behaviour after a merger is changed by the creation of an 'internal money market', a venue through which reserves can be exchanged internally. Through this internal market, the merged bank is able to increase the weight of its relatively illiquid assets, which is the group of assets where the bank can generate higher rates of return. Thus, if a sudden increase on the liability side occurs the bank will not have to be involved in so-called "asset fire sales". The reason that after a consolidation activity the bank's ability to increase the weight of illiquid assets is ameliorated, is the fact that an M&A activity reduces information asymmetries and enables them to screen borrowers more efficiently (Panetta et al. 2009).

3.3.1 Measurement of Liquidity

Liquidity creation by banks has historically been measured as the loans-to-asset ratio as shown in Hughes et al. (1996), or the ratio of cash and related liquid items to total assets - as proxies of bank liquidity (Molyneux and Thornton, 1992; Demirguc-Kunt and Huizinga, 1999). However, such liquidity indicators have been criticized as they do not consider comprehensive aspects of bank liquidity provision and the development of market conditions connected with financial markets (Shleifer and Vishny, 2010). The existing literature indicates that there have only been two papers that attempt to measure bank liquidity creation. The first is one by Deep and Schaefer (2004), where a measure of liquidity transformation is constructed and applied to data gathered from 200 of the largest US banks over the period 1997-2001. The liquidity transformation gap, or "LT gap" is defined as liquid liabilities minus liquid assets divided by total assets. The authors consider all loans with a maturity of one year or less to be liquid in this model and loan commitments and other off-balance sheet activities are explicitly excluded due to their contingent nature. Nonetheless, as discussed above, in order to precisely measure a bank's aggregate liquidity supply, all aspects of the balance sheet should be considered. To be more precise, liquidity that a bank provides is on one hand attributed to the structure of both the asset and liability sides, but on the other hand is attributed to off-balance sheet activities as well. This leads us to the second methodological attempt in the literature to gauge liquidity, proposed by Berger and Bouwman (2009). The authors averred that the "LT gap" is a step forward, but argued that it is not sufficiently comprehensive by highlighting a few differences between their approach and the LT gap developed by Deep and Schaefer (2004). Firstly, the

Berger and Bouwman (2009) model classifies loans by category as well rather than solely by maturity and employs measures which include off-balance sheet activities, consistent with the arguments of Kashyap et al. (2002), and Repullo (2004).

That said, Berger and Bouwman (2009) construct their liquidity creation measure using a three step approach. In the first step, they classify all bank balance sheet and off-balance sheet activities as liquid, semi-liquid, or illiquid based on the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds to meet customers' demands. Within each category, shorter maturity items are defined as more liquid than longer maturity items because they self-liquidate without as much effort. Loans are classified by category ("cat") or entirely by maturity ("mat"). In the second step, the authors assign weights to the activities classified in first step. The weights are based on the liquidity creation theory according to which banks create the most liquidity when as they transform, illiquid assets into liquid liabilities and maximum liquidity is destroyed when liquid assets are transformed into illiquid liabilities. Therefore positive weights are applied to both illiquid assets and liquid liabilities and negative weights to liquid assets and illiquid liabilities. They argue that the magnitudes of the weights are based on simple dollar-for-dollar adding up constraints, so that \$1 of liquidity is created (destroyed) when banks transform \$1 of illiquid (liquid) assets into \$1 of liquid (illiquid) liabilities. In the last step, they combine the activities as classified in the first step, and weighted according to the second step, in order to construct four liquidity measures. These measures classify loans by category or maturity ("cat" vs "mat") and differentiate on whether banks include off-balance sheet activities ("fat") or exclude them ("nonfat"). Detailed description of the three-step procedure is provided in table 3.2. Thus, four liquidity creation measures are constructed based on the four combinations "$catfat$", "$catnonfat$", "$matfat$", "$matnonfat$" and represented by the following equations:

catfat

$$\begin{aligned} LC \quad = \quad & \left\{\frac{1}{2} \times illiquidassets(cat) + 0 \times semiliquidassets(cat) - \frac{1}{2} \times liquidassets\right\} + \\ & \left\{\begin{array}{c} \frac{1}{2} \times liquidliabilities + 0 \times semiliquidliabilities - \frac{1}{2} \times illiquidliabilities \\ -\frac{1}{2} equity \end{array}\right\} + \\ & \left\{\begin{array}{c} \frac{1}{2} \times illiquidguarantees + 0 \times semiliquidguarantees \\ -\frac{1}{2} \times liquidguarantees - \frac{1}{2} liquidderivatives \end{array}\right\} \end{aligned} \tag{3.3.1}$$

cat − nonfat

$$\begin{aligned} LC \quad = \quad & \left\{\frac{1}{2} \times illiquidassets(cat) + 0 \times semiliquidassets(cat) - \frac{1}{2} \times liquidassets\right\} + \\ & \left\{\begin{array}{c} \frac{1}{2} \times liquidliabilities + 0 \times semiliquidliabilities - \frac{1}{2} \times illiquidliabilities \\ -\frac{1}{2} equity \end{array}\right\} \end{aligned} \tag{3.3.2}$$

matfat

$$
\begin{aligned}
LC &= \left\{\frac{1}{2}\times illiquidassets(mat) + 0\times semiliquidassets(mat) - \frac{1}{2}\times liquidassets\right\} + \\
&\left\{\begin{array}{c} \frac{1}{2}\times liquidliabilities + 0\times semiliquidliabilities - \frac{1}{2}\times illiquidliabilities \\ -\frac{1}{2}equity \end{array}\right\} + \\
&\left\{\begin{array}{c} \frac{1}{2}\times illiquidguarantees + 0\times semiliquidguarantees \\ -\frac{1}{2}\times liquidguarantees - \frac{1}{2}liquidderivatives \end{array}\right\}
\end{aligned} \tag{3.3.3}
$$

mat − nonfat

$$
\begin{aligned}
LC &= \left\{\frac{1}{2}\times illiquidassets(mat) + 0\times semiliquidassets(mat) - \frac{1}{2}\times liquidassets\right\} + \\
&\left\{\begin{array}{c} \frac{1}{2}\times liquidliabilities + 0\times semiliquidliabilities - \frac{1}{2}\times illiquidliabilities \\ -\frac{1}{2}equity \end{array}\right\}
\end{aligned} \tag{3.3.4}
$$

Berger and Bouwman (2009) suggest that "cat fat" is the preferred liquidity creation measure, because in this specific category they can treat business loans as illiquid regardless of their maturity because banks generally cannot easily dispose of them to meet liquidity needs, and they treat residential mortgages and consumer loans as semiliquid because these loans can often be securitized and sold to meet demand for liquid funds. In addition, this measure includes off-balance sheet activities, consistent with the arguments in Holmston and Tirole (1998) and Kashyap et al. (2002) who suggest that banks also create liquidity off the balance sheet through loan commitments and similar claims to liquid funds.

3.4 Empirical Methodology

3.4.1 Historical M&As - Liquidity Creation

The first step of our empirical methodology is to investigate the liquidity creation of all domestically completed M&As among financial depository institutions' in both countries throughout our sample periods. For this purpose, we compute using Berger and Bouwman (2009) preferred measure of liquidity creation, (i.e. catfat) the level of liquidity that the acquirer and the target creates one year before the M&A and the liquidity that is created from the new financial entity one year after the M&A activity. In turn, if we assume the consolidation occurs in time t we examine the involving financial intermediaries in terms of their liquidity creation in time $t-1$ and $t+1$. While Focarelli and Panetta (2003) note that a three years period is required for all the efficiency gains derived from the consolidation process to be realised, Erel (2009) highlights that considerable developments occur from the first year onwards. Thus, following Pana et al. (2010) we allow for a two year interval believing that it ideally captures the effect of the M&A on the level of liquidity created by the new financial institution demonstrated by the following equation:

$$difcatfat = catfat_{AB,t/t+1} - (catfat_{A,t/t-1} + catfat_{B,t/t-1}), \quad (3.4.1)$$

where $catfat_{AB,t/t+1}$, represents the level of liquidity created by the new financial institution one year after the M&A activity has been completed, whereas $catfat_{A,t/t-1}$ and $catfat_{B,t/t-1}$, represent the liquidity creation level of each financial institution one year before the consolidation process occurred.

3.4.2 Historical M&As - "Financial Fragility-Crowding out Hypothesis" vs "Risk Absorption Hypothesis" and the impact of "Deposit Insurance Hypothesis "

The primary reason why banks hold capital is to absorb risk, including the risk of liquidity crunches, protection against bank runs, and various other risks, most importantly credit risk. Although the reason why banks hold capital is motivated by their risk transformation role, recent theories suggest that bank capital may also affect banks' ability to create liquidity. These theories produce opposing predictions on the link between capital and the change in liquidity creation around mergers.

The "financial fragility-crowding out hypothesis" predicts that higher capital reduces liquidity creation. Diamond and Rajan (2001) model an investment bank that raises funds from investors to provide financing to an entrepreneur, in which the entrepreneur may withhold effort, which reduces the amount of bank financing attainable. More importantly, the bank may also withhold effort, which limits the bank's ability to raise funding. A deposit contract mitigates the bank's hold-up problem because depositors can run on the bank if the bank threatens to withhold effort and therefore maximises the liquidity creation. Providers of capital cannot run on the bank, which limits their willingness to provide funds, and hence reduces the liquidity creation – thus, the higher a bank's capital ratio, the less liquidity it will create. Gorton and Winton (2000) show a higher capital ratio may reduce liquidity creation through the crowding out of deposits and argue that deposits are more effective liquidity hedges for investors than investments in equity capital. Thus, the higher capital ratios shift investors' funds from relatively liquid deposits to relatively illiquid bank capital, reducing the overall liquidity for investors.

The "risk absorption hypothesis" argues that higher capital enhances banks' ability to create liquidity based on two strands of literature. The first argues that liquidity creation exposes a bank to risk as the more liquidity it creates, the greater the likelihood and severity of losses associated with having to dispose of illiquid assets to meet the liquidity demands of the customers (Allen and Santomero 1998; Allen and Gale 2004). The second argues that bank capital absorbs risk and expands banks' risk-bearing capacity (Bhattacharya and Thakor 1993; Repullo 2004; Von Thadden 2004; Coval and Thakor 2005). Combining these two strands yields the prediction that higher capital ratios may allow banks to create more liquidity.

Finally, a different hypothesis, the "Deposit Insurance Hypothesis", according to which banks with a higher level of deposit insurance are expected to perform higher levels of liquidity transformation, can be positively or negatively correlated, with respect to liquidity creation, with the two aforementioned hypotheses. The deposit insurance scheme states that the protection offered under a system of deposit insurance is a guarantee that all or a limited amount of the principal and the interest accrued on protected accounts will be paid. The guarantee may be explicitly given in law or regulation[5]. There are conflicting views

[5] The Basle Committee on Banking Supervision uses the term "deposit protection" instead of "deposit insurance." This distinction is understandable because deposit insurance differs from most other forms of insurance. In other words, bank failures are not the independent events that other forms of insurance typically cover. Rather, failures tend to occur in waves, partly in response to a severe recession or some other macroeconomic shock, partly because the legal/regulatory/ supervisory structure is inadequate, and partly because bank failures can be contagious when the failure of one bank brings down its counterparties (Garcia 1996)..

regarding the after-effect of a deposit insurance implementation. On one hand, it creates a more structured and regulated banking system which protects customers and mitigates bank-panics. On the other hand, it might cause the so called 'moral hazard' problem, where bank managers undertake excessive risk due to the presence of insurance on deposits as such.

In turn, a second step of our empirical methodology is to examine which hypothesis, the "Financial fragility-crowding out" and the "Risk absorption" hypothesi, characterizes each country's historical bank M&As. In addition, we attempt to shed light on any implications of the "Deposit Insurance Hypothesis" in regard to the liquidity creation of the new financial entity one year after the consolidation has been completed.

Model

We base our analysis on the preferred liquidity measure of Berger and Bouwman (2009), more specifically the "$catfat$". We test all the M&As that took place during our sample, to check the level of liquidity provision in the years after the M&A activity has been completed. Following Pana et al. (2010), in order to examine the "Financial fragility-crowding out" , "Risk absorption" and "Deposit Insurance Hypothesis" the following regression equations are estimated:

$$\left(\frac{catfat}{GTA}\right)_{i,t+1} - \left(\frac{catfat}{GTA}\right)_{i,t-1} =$$

$$a_0 + a_1\left(\frac{UninsuredDeposits}{GTA}\right)_{i,t-1} + a_2\left(\frac{Bankcapital}{GTA}\right)_{i,t-1}$$

$$+a_3 \operatorname{Re} lativesize_{i,t-1} + a_4 Publicstatus_{i,t-1} + a_5 GDP_{i,t-1} + \varepsilon_{i,t} \quad (3.4.2)$$

The variables are defined as follows: *'catfat'* represents the liquidity measures based on category for the merged banks at $t+1$ and the pro-forma bank at $t-1$, *'uninsured deposits'* are the total uninsured deposits of the acquirer bank before the merger and *Bankcapital* is the amount of equity capital of the acquirer bank before the merger. These three variables are all normalised by the gross total assets (GTA). *Relative-size* is the ratio of target and acquirer GTA. *Publicstatus* is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and GDP is the real gross domestic product. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity.

As argued under the "risk absorption" hypothesis, it is important to appropriately control for bank risk as the main reason for banks to hold capital is to be able to absorb risk. Further, Berger and Bouwman (2009) suggest that inclusion of risk measures in the analysis could help isolate the role of capital in the liquidity creation function from its role in supporting risk transformation functions of banks. That said, in order to measure the bank's ability to absorb shocks occurring from the mergers and acquisitions, we use the Herfindahl-Hirschman of revenue (HHI_{REV}) diversification measure (Stiroh 2004):

$$HHI_{REV=}\left(\frac{NON}{NETOP}\right)^2+\left(\frac{NET}{NETOP}\right)^2 \tag{3.4.3}$$

$$NETOP = NON + NET \tag{3.4.4}$$

where NON is non interest income, NET is net interest income, and $NETOP$ is net operating revenue.

As the HHI_{REV} rises, the bank revenue stream becomes more concentrated and less diversified. While other measures of bank risk absorption ability are more popular in the banking literature (e.g. the ratio of commercial real estate to total loans, or the ratio of jumbo certificates of deposit (CDs) to assets), the revenue diversification measure is preferred because it avoids the use of balance sheet items, and thus mitigates the endogeneity problem. In addition, we split all the M&As under investigation into large and small acquirers, in order to identify any patterns linking size and the three aforementioned hypotheses of interest.

3.4.3 Recent & Potential M&As - "Cost Efficiency-Liquidity Creation Hypothesis" (CELCH)

In the third step of our empirical strategy we examine whether those M&As could lead to an increase of liquidity in the banking sector and in turn, to an increase of the credit channels (i.e loans) in the economy, especially in the spectrum of a severe country default risk. This has an additional policy implication as far as the 'true' incentives that trigger an M&A activity is concerned, i.e., a trade-off between shareholders' personal gains and society's economic prosperity. To conduct our analysis, we create potential mergers and acquisitions between the most important financial institutions in terms of assets, loans and deposits in the UK and Greek banking sector respectively and we compare their potential liquidity creation with the sum of each individual bank's liquidity creation. Nevertheless, this raises the following challenge; "How we will be able to measure potential liquidity creation?". Since the liquidity creation is measured by the recently proposed in the literature liquidity measures of Berger and Bouwman (2009) and due to the fact those measures are constructed by an accounting and not by an estimation procedure, consequently, I cannot calculate the liquidity creation of potential M&As. To be more explicit, let's assume bankA and bankB where we have data for both them in time $t-1$, t and in time $t+1$ as well and we calculate each bank's liquidity creation (i.e 'catfat') in all three points in time. Let's assume now that we create a potential consolidation activity among these two banks (bankAB) in time t. If we try to calculate the liquidity creation difference between the 'new' bank (i.e the merged bank) in time $t+1$ and the two 'old' ones (i.e the proforma bank) in time $'t-1'$ the result will be:

$$difcatfat = catfat_{AB,t/t+1} - (catfat_{A,t/t-1} + catfat_{B,t/t-1}) = n \quad (3.4.5)$$

, where n could be a positive, negative or even equal to zero number depending on the values of the level of liquidity creation of all three financial instutitions, i.e. AB, A, B, in both points in time. Nonetheless, any result of equation 3.4.5 would derive incorrect conclusions. The culprit here would be the AB financial institution, since '$catfat'_{AB,t/t+1}$' does not represent the liquidity creation of a hypothetical *merged* bank, as it was explained in section 3.4.1, but of a hypothetical *proforma* bank. since the consolidation process has not occurred historically and thus we cannot observe its effect on the level of liquidity creation.For this reason, we introduce the "*Cost Efficiency - Liquidity Creation Hypothesis*" which states that after a consolidation activity if the new financial institution has cost efficiency gains these can be reflected to liquidity creation enhancement. Thus, we propose to measure the liquidity creation of a potential M&A through its potential level of efficiency. It is noteworthy that banks' efficiency enhancement is an explicit policy objective in the Single Market Directive of the European Commission, highlighting is importance.

Nonetheless, at this point it is important to provide a theoretical justification for our proposed methodology. Put it differently, we need to explain in detail our theoretical motivation and methodological steps which combine the concepts of efficiency, M&As, liquidity creation and social benefit.

During the last decade, antitrust and competition law assessment of M&As has altered to accommodate growing scepticism with the use of concentration and market share measures (Hausman and Sidak, 2007; Werden, 2002). Subsequently, a crucial criterion for judging potential mergers as acceptable is their ability to pass on merger-specific efficiency gains to customers. This efficiency pass-through criterion is explicitly stated in the US and EU merger guidelines (Neven, 2006) and is employed in Australia in an informal manner. In other words, the first theoretical pinpoint for a bank-consolidation to be acceptable it to create synergies and pass on these benefits to customers.

Additionally, economic theory suggests that mergers can be an efficient means to restructure an industry, and the subsequent efficiency gains from mergers can be larger than customer losses from increased market concentration. Copious theoretical studies have investigated the relationship between merger-specific efficiency and price changes. The first to date was by Williamson (1968), who claimed that merger-specific cost efficiency gains outweighed possible anticompetitive effects. Within this general framework, increased cost efficiency arising from mergers can be larger than the deadweight loss of reduced production which stems from the increase in market power. In turn, we may experience a trade-off between efficiency gains and anticompetitive effects of M&As as efficiency enhancement could result in a limited price increase. Consequently, as a second point we argue that M&As can lead to an increase in efficiency.

In a later study Farrell and Shapiro (1990), demonstrate that if a merger generates no synergies (efficiencies) and does not lower marginal costs, prices will rise. Thus, they argue M&As can only be contribute to the social well-being when efficiency has increased substantially and these gains are passed on to consumers. Consequently, as a third point we conclude that efficiency enhancing M&As could lead to consumer benefits.

Nonetheless, the positive effect of a consolidation process is influenced as well by the size of the involved financial institutions. On one hand M&As of small banks increase the market share of larger more efficient banks and thus increase the market's total surplus. On the other hand M&As of large banks shift market share to less efficient smaller banks which need additional efficiency gains to increase total surplus. In a very recent study, Park and Pennacchi (2009) examine the differences in pricing effects of large and of small banks. Their results indicate that as large merging banks borrow relatively more funds from money markets rather than from retail deposits, large bank mergers will result in a reduction in rates for depositors and improve rates for borrowers. Consequently, as a fourth point we conclude that large banks' M&As could ameliorate the terms of the issuing loans from the point of view of the borrowers.

DeYoung et al., (2009), despite the fact that they show that US bank M&As have an negative impact on efficiency, their empirical evidence on European bank M&As reveals on the contrary a positive impact on efficiency. Moreover, Haynes and Thompson (1999) note that UK bank mergers have been associated with positive performance effects and Ashton and Pham (2007) infer that UK (and German) bank mergers have led to significantly enhanced cost efficiency for the merging banks. Consequently, as a fifth point from the two aforementioned studies, we are confident that the examination of liquidity creation of potential UK and Greek banks' M&As is in line with the established criteria of EU M&As guidelines, and these potential consolidation activities can be proclaimed as acceptable.

The empirical evidence of Berger and Bouwman (2009) highlights that recently completed banks' M&As account for the industry's overall liquidity. This is in line with the most recent study of Pana et al. (2010) and with the vast majority of our earlier findings regarding all historical UK and Greek M&As. Thus, as a sixth point, we infer that consolidation activity results in an increase in liquidity creation.

According to the theory of economic efficiency, a financial institution can enhance its cost efficiency if it manages to achieve the minimum level of inputs costs to produce a certain level of outputs. A way this can be done is by establishing a new business plan which can enable the bank to exploit economies of scale or economies of scope. Additionally, it can acquire or invent more sophisticated technology which can result in reducing its inputs' unit cost. Alternatively, cost efficiency can be achieved by minimizing information asymmetries which will result to the minimization of costs. According to the banking efficiency theory one of the main outputs of banks is loans. The primary problem that banks face with loans is the level of those that are 'not performing'[6]. Nevertheless, if a bank is being able to reduce its information asymetries then it ameliorates its ability to screen borrowers and thus reducing the level of non-performing loans. Consequently, it can reallocate its resources and increase the weight of loans; i.e., illiquid assets, which results to increase in liquidity creation. As we discussed earlier a consolidation activity reduces information assymmetries and results in

[6] A Non-performing loan (NPL) is a loan that is in default or close to being in default. Many loans become non-performing after being in default for 90 days, but this can depend on the contract terms.

increased liquidity, in turn, with the same mechanism strategies that result in cost efficiency can result in increased liquidity and consequently in increased flow of credit to the economy.

Thus, from the seven aforementioned points, we build the theoretical intuition for "*Cost Efficiency - Liquidity Creation Hypothesis*", which argues that potential scenarios of M&As which exhibit higher levels of economic efficiency compared to the average individual level of efficiency of the involving financial institutions (without completing the M&A) can create as well higher levels of liquidity creration (against the same benchmark) with enhanced lending rates for the borrowers.

Next challenge is to demonstrate a mathematical proof of this reasoning. In order to achieve that, let's use for one more time the above hypothetical scenario of bankA, bankB, and the potential bankAB in time $'t'$.

To estimate the level of economic efficiency and specifically the level cost efficiency[7] , we opt for the stochastic frontier approach (SFA)[8] under the intermediation approach by Sealey and Lindley (1977)[9]. In particular, we follow the specification:

$$\ln TC_{it} = \ln C(y_{it}, w_{it}, T, E_{it}\ ; \beta) + u_{it} + v_{it}, \tag{3.4.6}$$

where subscripts $i = 1, ...N$ stand for each financial institution (i.e. each M&A activity), $T = .year1, year2..., final\text{-}year$, and indicates a

[7] Due to unavailability of data on output prices we don't estimate profit efficiency.

[8] Kubhakar and Lovell (2000) is an excellent guide on Stochastic Frontier analysis and its parametric framework on the estimation of efficiency.

[9] Several approaches have been suggested in the literature in order to define bank inputs and outputs (for a review see Berger and Humphrey, 1992). In our study we are interested in the estimation of overall efficiency and economic viability of potential banks' M&A and its relationship with liquidity creation, thus, the intermediation approach seems to fit better the purposes of our analysis (Berger and Mester, 1997).

time trend and is included in each specification to allow for technological change, using both linear and quadratic (i.e. T and T^2) respectively. TC_{it} is individual bank total cost; y_{it} and w_{it} indicate vectors of output and input prices; we specify equity (E) as a quasi-fixed input to control for differences in risk preferences, which may arise due to regulation, financial distress, or informational asymmetries; β is a vector of parameters to be estimated. The two-sided random error term v_{it} is assumed to be independent of the non-negative cost efficiency variable u_{it} and is assumed to follow a symmetric normal distribution around the frontier and ui, accounts for the firm's inefficiency and is assumed to follow a half-normal distribution. To empirically implement the cost frontier, we opt for[10]:

$$\begin{aligned}
\ln TC_{it} \quad = \quad & \beta_0 + \sum_{l=1}^{2} \beta_{yl} \ln y_{it,l} + \sum_{s=1}^{2} \beta_{ws} \ln w_{it,s} + \frac{1}{2} \sum_{l=1}^{2} \sum_{s=1}^{2} \beta_{ylys} \ln y_{it,l} \ln y_{it,s} \\
& + \frac{1}{2} \sum_{l=1}^{2} \sum_{s=1}^{2} \beta_{wlws} \ln w_{it,l} \ln w_{it,s} + \sum_{l=1}^{3} \sum_{s=1}^{3} \beta_{ylws} \ln y_{it,l} \ln w_{it,s} \\
& + (\sum_{s=1}^{2} \beta_{ws} \ln w_{it,s}) * T + (\sum_{l=1}^{2} \beta_{ws} \ln y_{it,l}) * T + \beta_E \ln E_{it} \qquad (3.4.7) \\
& + \beta_t T + \frac{1}{2} \beta_{tt} T^2 + u_{it} + v_{it}
\end{aligned}$$

Standard linear homogeneity and symmetry restrictions in all quadratic terms are imposed in accordance with economic theory. It's noteworthy to mention that efficiency values range between 0 (the least efficient financial institution in the sample) and 1 (the most efficient financial institution in the sample).

[10] The translog function has been widely applied in the literature due to its flexibility. Berger and Mester (1997) found that both the translog and the Fourier-flexible form specifications yielded essentially the same average level and dispersion of measured efficiency, and both ranked the individual banks in almost the same order.

If we attempt now to calculate the difference between the level of the estimated economic (cost) efficiency of the 'new' bank and of the two 'old' ones in both points in time the result will be:

$$difeff = eff_{AB,t} - \frac{(eff_{A,t} + eff_{B,t})}{2} \neq 0^{11}, \qquad (3.4.8)$$

simply because efficiency is a result of an empirical estimation procedure, whereas Berger and Bouwman (2009) liquidity measures are rather a result of an accounting procedure where,

$$difcatfat = catfat_{AB,t} - (catfat_{A,t} + catfat_{B,t}) = 0 \qquad (3.4.9)$$

Thus, from equations 3.4.7 and 3.4.8 we can create the following hypothesis: If

$$eff_{AB,t} \succ \frac{(eff_{A,t} + eff_{B,t})}{2}, \qquad (3.4.10)$$

then

$$\mid catfat_{AB,t} \mid * eff_{AB,t} \succ \frac{(eff_{A,t} + eff_{B,t})}{2} * \mid (catfat_{A,t} + catfat_{B,t}) \mid \qquad (3.4.11)$$

which results in

$$dif(eff_{AB,t} - \frac{(eff_{A,t} + eff_{B,t})}{2}) * \mid catfat_{AB,t} \mid \succ 0, \qquad (3.4.12)$$

where as it can be seen both sides of the inequality 3.4.11 are calculated in the same point in time when the hypothetical M&A takes place (i.e. t). Note that liquidity creation can be negative (i.e, bank destroys liquidity), for this reason we include the absolute value of $catfat$ in both inequalities 3.4.11 and 3.4.12. In this way, we provide a *logic*

[11] Due to the fact that efficiency is computed via the parametric Stochastic frontier approach (SFA) and is expressed as a ratio of the actual observed level of efficiency to the optimum level of efficiency of the best-practice bank in the sample, we cannot use the sum (as we did with respect to the measurement of liquidity of two banks in section 3.4.1) but instead we take the average level of efficiency of the involving financial institutions.

mathematical sequence of a theoretical hypothesis regarding liquidity gains or losses associated with the economic efficiency stemming from a potential consolidation process among several financial institutions. In this way we are able to evaluate and compare the 'liquidity-efficiency' gains or losses of potential M&A activity. This is of extreme importance for policy makers and practitioners, since after the onset of the global financial turmoil we have witnessed numerous cases of banks' M&A world-wide and there are daily speculations about new ones. Thus firstly, in the spirit of Basel III, where a major emphasis is given on liquidity and implemented by the introduction of two ratios, namely the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR), we investigate whether potential consolidation activity can create neuralgic and necessary credit channels in the economy that are essential for its recovery and for the promotion of growth in an era where the adverse effects of the global financial turmoil are still visible. While secondly, we are able to extract policy implications about the true origins of a M&A activity, in terms of promoting the social well-being or managerial purposes by investigating whether a trade-off between shareholders' personal gains and society's economic prosperity exists.

For this purpose, as it was aforesaid we select the largest financial institutions in terms of assets, loans and deposits of both the UK and the Greek banking sector and we create potential mergers and acquisitions scenarios among them. Furthermore, we conduct a comparative analysis pre-crisis and post crisis. As far as the examination of the former period is concerned we use data of the financial institutions up to 2006, whereas for the investigation of the latter period we use data up to 2011. In this way, we test whether the level of liquidity associated with efficiency that had been created by the same potential M&As has changed due to the crisis. This has crucial distinct contribution for each banking system and major policy implications towards its stability. On one hand we are able to provide empirical evidence of whether the BoE could scale back its unconventional monetary policy (i.e. QE, FLS) in two different points in time and how different the future of UK economy and its financial institutions which experienced a great negative impact of the crisis could be, had they involved in a consolidation process earlier. On the other hand, we can investigate whether potential M&As could have been proved vital in alleviating the terms of each of the two memorandums between Greece and the so-called Troika, enhancing the real economy, households and firms, with the creation of additional credit channels.

Specifically in the Greek banking Sector, we select all the remaining banks that have not been involved in the recent wave of consolidation of the four systemic banks and we create all potential combinations of M&As either among themselves or with one of the four cornerstones of the Greek economy. Additionally we control for both single and multiple M&As by one banking institution. Last but not least, regarding the four systemic banks, we examine both their 'recent'[12] and potential M&As in every possible combination (i.e. either one-by-one, two-by-two, etc. or by all the acquired banks together), in order to test what would be the bank's liquidity creation associated with its economic efficiency if it hadn't been involved in the recent consolidation process and focus only in the potential cases of M&As[13].

[12] Regarding the 'recent' M&As cases that the Greek banking sector experienced, we approach each one of these cases as a potential scenario in the economy, since our sample is dated up to 2011 and the recent consolidation wave took place in 2012 and 2013.

Additionally, to construct the potential M&As combinations we exclude the banks that their operations have been terminated in the last year of our sample (i.e. 2011) and those who have terminated their operations after 2011 till present in order the results to be of relative policy importance.

[13] We thoroughly examine that each of the following financial institutions for

3.4.4 Stress test scenario

In the fourth step of our empirical methodology, we want to examine whether potential bank consolidation activity will create the essential dynamics that will enhance the 'liquidity-stability' of the sector overall in the face of future adverse economic conditions. Our intuition derives from the tremendous impact the recent financial meltdown had on the stability of financial intermediaries. Bank liquidity was traditionally viewed as of equal importance to solvency. Liquidity risks are inherent in maturity transformation, i.e., the usual long-term maturity profile of banks' assets and short-term maturities of liabilities. Banks have commonly relied on retail deposits, and, to some degree, long-term wholesale funding as supposedly stable sources of funding. Yet, attention to liquidity risk diminished in recent decades, as symbolized by the absence of consideration of liquidity risk in the 1988 Basel I framework. The global financial crisis has clearly shown that neglecting liquidity risk comes at a substantial price. Over the last decade, large banks became increasingly reliant on short-term wholesale funding (especially in interbanking markets) to finance their rapid asset growth. At the same time, funding from non-deposit sources (such as commercial paper

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each banking sector is not a subsidiary of the rest.

Precisely from the UK banking sector we select: AIB plc, Barclays Bank plc, Royal Bank of Scotland plc, HSBC Bank plc, Lloyds TSB Bank plc, Standard Chartered Bank plc, Santander UK plc, Co-operative Bank plc , Sainsbury's Bank plc and UBS plc.

While from the Greek banking sector we choose, National bank of Greece (or Ethinki bank), EFG Eurobank, Alpha bank, Piraeus bank, Attica bank, Panellinia bank, Pancretan Co-operative bank, Aegean bank, Commercial bank (or Emporiki bank), Agricultural bank (or ATE bank), Marfin-Egnatia bank, TT-Hellenic, Genini bank, Millenium bank, Proton bank, Probank, FBB bank. The last thirteen banks have been already absorbed by the four new 'systemic' banks National bank of Greece or Ethinki bank (acquired Probank, FBB bank) , EFG Eurobank (acquired TT-Hellenic, Proton bank), Alpha bank (acquired Emporiki bank), Piraeus bank (acquired ATE bank, Marfin-Egnatia bank, Genini bank, Millenium bank).

placed with money market mutual funds) soared. With the unfolding of the global financial crisis, when uncertainties about the solvency of certain banks emerged, various types of wholesale funding market segments froze, resulting in funding or liquidity challenges for many banks. In the light of this experience, there is now a widespread consensus that banks' extensive reliance on deep and broad unsecured money markets pre-crisis is to be avoided. Consequently, it is one thing to present potential consolidation activity that can ameliorate the social welfare via enhanced cost efficiency and liquidity creation and a completely different story to know whether this social benefits can still be existing after a hypothetical financial crisis with its calamitous contagion effects as the one that was triggered in August 2007 and was climaxed by the Lehman Brothers collapse in September 2008.

In order to investigate the robustness of the UK and the Greek banking sector's liquidity creation, we create a hypothetical environment, similar to a stress test scenario. The idea here is to create a stress environment which will be composed by the potential scenario of liquidity shortage faced by the banks due to adverse macroeconomic, financial and bank-specific conditions as well. In other words, we stress each country's economy in three different ways: by a macroeconomic, a financial and a bank shock. We use for each country the real growth rate of gross domestic product (GDP) to account for macroeconomic conditions, the level of policy interest rates described by the three month treasury bill rate and the level of the real effective exchange rate to account for financial distress and the level of total problem loans in each banking sector to capture banks' liquidity risk. The literature suggests that these specific variables directly affect the liquidity of banks. Additionally, since banking theory considers a high level of efficiency as the preponderant precondition against a bank's default, we account for an additional bank-specific shock; the cost efficiency score of each potential combination of banks' M&A and of each financial institution in each country that we used in the previous subsection, in order to examine how its deviation affects liquidity creation. To the best of our knowledge this is the first study in the literature that addresses the impact of efficiency on liquidity creation and additionally, the direction of causality among those two variables.

To pursue this analysis, our econometric procedure lies upon the framework of a vector autoregressive (VAR) model to implement a stress test in banking. A vast body of literature endorses the fact that the changes in the macroeconomic conditions of any economy do impact banks' performance, simultaneously or with lag. It is also possible that the feedback effects of bank instability on real economic activity could amplify the fluctuations especially during recessions. Therefore, in order to judge the resilience of banking on various macroeconomic shocks, Vector Autoregressive (VAR) approach has been adopted, as done by Hoggarth, Sorensen and Zicchino (2005), Marcucci and Quagliariello (2005) and Filosa (2007). The advantage of the VAR model is that it allows to fully capture the interaction among macroeconomic and financial variables and bank's specific variables. It also captures the entailed feedback effect. We use a panel-data vector autoregression methodology (Holtz et al. 1988).This technique combines the traditional VAR approach, which treats all the variables in the system as endogenous, with the panel-data approach, which allows for unobserved individual heterogeneity (Love and Zicchino, 2006).

In turn the PVAR can be represented in the following general form:

$$Z_{it+p} = \Gamma + \sum_{j=1}^{q} \Phi_j Z_{it+p-j} + \varepsilon_{it+p} \tag{3.4.13}$$

where, $i = 1, 2, 3..I$ represents each panel (i.e. different bank), Γ is a constant vector, Φ_j are matrices, ε_{it+p} is a vector of residuals/shocks, and p denotes the forecasting time horizon. Z_{it+p-j} is the vector of endogenous variables including the real growth rate of GDP, the policy interest rates, the real effective exchange rate, the three month treasury bill rate, the level of bad loans loans, cost efficiency estimates and the level of liquidity creation calculated as before by the preferred measure "*cat fat*". We are mainly interested in examining the behaviour of the liquidity creation and cost efficiency variable. The equation in the model for the preferred measure of liquidity creation and thus the equation defining the shock to the preferred measure of liquidity is of the following form:

$$lc_{it+p} = \gamma_{lc} + \phi_{lc} Z_{it+p-1} + \varepsilon_{lc,it+p} \tag{3.4.14}$$

where lc_{it+p} represents the liquidity creation measure("*cat fat*"), $\varepsilon_{lc,it+p}$ is a white noise shock, γ_{lc} is a constant, ϕ_{lc} is a row vector of parameters corresponding to the row of coefficients in Φ_p in the equation for liquidity creation. Z_{it+p-1} is the vector of the variables included in the VAR including liquidity creation itself. The last equation describes the determinants of the bank liquidity creation which are lagged values of the variables included in the VAR. Modelling the dynamics of the macroeconomic, financial, bank-specific variables and the liquidity creation variable using a VAR has the advantage that impulse response analysis can be carried out – the stress test proposed in this paper. By estimating the system, it is possible to simulate various shocks to these variables and consider the feedback from these shocks to the level of liquidity created by a bank and thus the aggregate level of a country's liquidity need. Equivalently, one can investigate whether shocks to the liquidity of the banks have an impact on future macroeconomic, financial and bank developments.

In the same spirit the equation in the model for the economic efficiency and thus the equation defining the shock to the cost efficiency scores is of the following form:

$$ceff_{it+p} = \gamma_{lc} + \phi_{lc} Z_{it+p-1} + \varepsilon_{ceff,it+p} \qquad (3.4.15)$$

where the left hand-side variable; $ceff_{it+p}$, represents bank-specific cost efficiency estimates.

An appealing fact of the VAR modelling is that it does not require the imposition of strong structural relationships, although theory is involved to select the appropriate normalization and to interpret the results. Another advantage is that only a minimal set of assumptions is necessary to interpret the impact of shocks on each variable of the PVAR system. The reduced form VAR, once the unknown parameters are estimated, permits implementing dynamic simulations. This method only allows for the analysis of short-run adjustment effects and not of structural long-run effects. The results come in the form of impulse response functions (IRFs) and their coefficients analysis, as well as forecast error variance decompositions (FEVDs) that let one examine the impact of innovations or shocks to any particular variable on other variables in the system. IRFs model the dynamics of the response; the coefficients represent the average effects of IRFs and permit recognizing the significance of the overall response, while variance decompositions give information about the variation in one variable due to shock to the others. The response corresponds to a one-time shock in other variables, holding all the other shocks constant at zero. In other words, orthogonalizing the response allows us to identify the effect of one shock at a time, while holding other shocks constant.

Since the variance-covariance matrix of the VAR residuals/shocks is unlikely to be diagonal, the residuals need to be orthogonalised in order to obtain orthogonalized impulse response functions. Consequently, we decompose the residuals in a way that makes them orthogonal. Such exercises require applying a careful VAR identification procedure. The most common way to deal with this problem is to choose a causal ordering. A standard procedure in the literature is to apply a Cholesky decomposition, which is equivalent to adopting a particular ordering of the variables and allocating any correlation between the residuals of any two elements to the variable that is ordered first. It is well known that these impulse response functions can be sensitive to the ordering of the variables. In turn, the variables in the model were initially ordered in ascendance according to the likely speed of reaction to any particular shock. Variables at the front end of the VAR are assumed to affect the following variables contemporaneously but only to be affected themselves by shocks to the other variables after a lag. Variables at the bottom of the VAR, on the other hand, only affect the preceding variables after a lag but are affected themselves immediately. The financial variables; three month treasury bill rate and the level of the real effective exchange rate, were ordered at the bottom of the VAR implying that they react instantaneously to shocks in the real side variables whereas the remaining variables (the growth rate of gross domestic product, the level of total problem loans, the estimated cost efficiency and the level of liquidity creation,) react only after a lag following shocks to the financial variables. The growth rate of gross domestic product was ordered after the level of total problem loans and economic efficiency respectively, reflecting priors that the economic cycle affects bank losses. Last was ordered the liquidity creation variable[14].

[14] Note that the ordering would be irrelevant if there are low estimated covariances between the errors across equations. Preliminary results show that indeed these covariances are low.

In applying the VAR procedure to panel data, we need to impose the restriction that the underlying structure is same for each cross-sectional unit. Since this constraint is likely to be violated in practice, one way to overcome the restriction on parameters is to allow for "individual heterogeneity" in the levels of the variables by introducing fixed effects, (Love and Zicchino, 2006). Hence, equation 3.4.12 becomes

$$Z_{it+p} = \Gamma + \sum_{j=1}^{q} \Phi_j Z_{it+p-j} + d_{it} + \varepsilon_{it+p}, \tag{3.4.16}$$

where d_i denotes the fixed effects.

Since the fixed effects are correlated with the regressors due to lags of the dependent variables, the mean-differencing procedure commonly used to eliminate fixed effects would create biased coefficients. To avoid this problem we use forward mean differencing, also referred to as the 'Helmert procedure' (see Arellano and Bover, 1995). This procedure removes only the forward mean, i.e., the mean of all the future observations available for each bank-year. This transformation preserves the orthogonality between transformed variables and lagged regressors, so we can use lagged regressors as instruments and estimate the coefficients by system GMM. Further, to analyze the impulse response functions we need an estimate of their confidence intervals. Since the matrix of impulse-response functions is constructed from the estimated VAR coefficients, their standard errors need to be taken into account. We calculate standard errors of the impulse response functions and generate confidence intervals with 1000 Monte Carlo simulations[15]. Finally,

[15] In practice, we randomly generate a draw of coefficients of model (1) using the estimated coefficients and their variance covariance matrix and re-calculate the impulse-responses. We repeat this procedure 1000 times (we experimented with a larger number of repetitions and obtained similar results). We generate 5th and 95th percentiles of this distribution that we use as a confidence interval for the impulse-responses.

we also present variance decompositions, which show the percentage of the variation in one variable that is explained by the shock to another variable, accumulated over time. The variance decompositions show the magnitude of the total effect. We report the total effect accumulated over ten, twenty and thirty periods ahead.

That said, we compare the stability with respect to liquidity of the whole banking system for each hypothetical M&A scenario against a baseline case where no consolidation activity has been enganged in the sector. We note that regarding the Greek banking sector we create an additional baseline case which incorporates all the recent consolidation activity that took place in the country despite the fact that some specific M&A formations were found as 'cost efficiency-liquidity creation' enhancing[16]. In this way we are able to make accurate comparisons between the two benchmark banking status and extract important inferences from a policy perspective.

Lastly, in order to be able to make presice comparisons in an appropriate way among these baseline cases and the various combinations of potential banks' M&As, we use the concept of '*half-life*', since it represents a measure for assessing the speed of mean reversion or persistence in the variable of interest. Precisely, we employ the recently proposed *'half life'* measures of Chortareas and Kapetanios (2013)[17] and we calculate the *'half life'* of the response of liquidity creation to each specific shock for each specific potential M&A activity by the following equation:

$$\int_{o}^{h^*} \mid \phi_i \mid d_i = \int_{h^*}^{\infty} \mid \phi_i \mid d_i \qquad (3.4.17)$$

where we define the impulse response as a function of i, which we

[16] This baseline scenario will include only the final formation of the four systemic banks, after their series of consolidation activity and the potential M&A category.

[17] For a recent summary see also Choi, Mark, and Sul (2006).

denote as ϕ_i to provide a distinction in focus from standard impulse responses and d_i is the order of intergration. Then, the half-life is the point h^*. In other words, h^* is the point in time at which half the absolute cumulative effect of the shock has dissipated.

3.5 Data

We use annual data that consists of an unbalanced panel of all the financial institutions that provided credit[18]during the years 1988-2011 in the UK and 1993-2011 in Greece[19]. Following the majority of empirical studies in banking, we obtain the largest part of our bank-level data from the Bankscope database of Bureau Van Dijk's company. Any missing information is filled in from the official websites of UK and Greek financial institutions, by the British Bankers and Building Societies Association, the Hellenic Bank Association, and by the annual reports of both the governors of Bank of England and of Bank of Greece. Overall, both our samples account for a significant market share in terms of assets, loans and deposits, occasionally even more than 90% in each respective category in both countries. More precisely, the UK sample comprises 2,324 observations for 162 financial institutions, whereas the Greek sample consists of 30 financial institutions with a total of 356 observations. The main difference between the two banking sectors is that 'Commercial' banks incorporated in Greece are the dominant

[18] Our sample consists of Commercial banks, Real Estate and Mortgage Banks, Bank Holding Companies, Cooperative Banks and Savings Banks.

[19] The reasoning behind selecting 1993 as the starting year for the sample regarding the Greek banking sector is because in that year the full liberalization of the Greek banking system occurred. This followed the provision of the Second Banking Directive regarding establishment, supervision and operation in 1992 by the Basic Banking Law Banking Directive.

group in the banking system. The dominance of commercial banking can also be confirmed by the number of branches and employees. Greek commercial banks have 3,302 branches in operation (out of 3,575 for all credit institutions which is equivalent to 92.36%), while the number of their employee's stands at 51,012 (out of 56,611 employed in all credit institutions which is equivalent to 90.11%) according to the Hellenic Banking association (2011).

At this point we highlight a number of crucial points that we take into account in our data selection strategy. This strategy is of major importance in terms of accuracy of the results and of the inferences based on them. Regrettably it has been mistakenly disdained by the bulk of the empirical studies that have used Bankscope database (see Claessens and van Horen, 2012 and Clerides et. al 2013). To be more precise, first, we check both samples for double-counting observations. Bankscope provides company account statements for banks and financial institutions across the world by collecting financial statements with both consolidation and unconsolidation status. We select the unconsolidated data[20] and exclude the equivalent consolidated data to avoid double counting the same financial institution.

As a second step, we take into consideration mergers and acquisitions (M&A). For this purpose we thoroughly went through all M&A activities that took place in the past in both banking sectors so that only the merged entity or the acquiring bank remains in the sample after a take-over. As an intuitive example: assume that bank A and bank B merged in 2003 to create a new entity, bank C, then the two individual banks A and B are each included in the dataset until 2003. From 2003 onwards, these two banks' operations are considered to be

[20] In cases where unconsolidated data were not available, we chose consolidated data instead.

terminated and the new bank (bank C) is included in the database. In the same spirit, assume that bank A was acquired by bank B in 2003; both banks are included in the database until 2003, with bank A then becoming inactive after 2003 and bank B remaining active after 2003. We obtain detailed information on mergers and acquisitions from the Zephyr database of Bureau Van Dijk's company.

All data are deflated using each country's GDP deflator (using 2005 as the base year) obtained from the World Bank database and converted to US Dollars. In addition to the two considerations in our data filtering process, we exclude observations of missing, negative or zero values for inputs/outputs and control variables. Our final samples account for 124 financial institutions and 1834 observations for the UK banking sector and for 30 financial institutions and 356 observations for the Greek banking sector.

3.5.1 Developments

During the years studied, important structural changes and developments occurred within the European Union countries and world-wide which influenced both countries' financial systems. We experienced the introduction of the Economic and Monetary Union (EMU), the macroeconomic stabilization programme, the establishment of advanced information technologies and the internationalization of banking activities, which enhanced competition in both price and quality levels. Important changes took place on a domestic level as well. Regarding the Greek banking sector, the most important development, was the establishment of the Euro as the country's common currency and sole legal tender[21].

[21] Greece joined the Eurozone in 2001. Currently, 17 out of the 28 members of the European Union use 'Euro' as their national currency.

Additionally, a major structural feature of the Greek financial system, characterizing in particular the old banking regime, is the significant level of state intervention, which for a long time hindered competition and created a distorted market environment. In the early 1990s, the state commercial banks controlled around 85 per cent of total commercial banking operations. Since then, a notable trend observed in the Greek banking sector was the privatization of several banks controlled by the Greek state, which contributed to the enhancement of competition in the market. That said, the country's banking sector has a Herfindahl index [22] figure of 1,278 , higher than the average European Herfindahl index which is 1,102 for the 27 countries members of the European Union (1,195 for the 17 countries members of the European Monetary Union) (European Central Bank, 2011), which highlights a picture of a concentrated banking sector. Finally, during the first half of the 1990s, new private-owned foreign commercial banks were established, taking advantage of new products and services that were not available in the Greek market just a decade ago.

Turning to the UK banking sector, it is noteworthy that the building society sector, having continued to expand during the 1980s and 1990s, saw a sharp contraction in the mid-late 1990s, as many building societies demutualised and became banks. Another major development saw the largest UK banks become truly 'universal' banks, by expanding the range of their activities and services. Specifically, now they encom-

[22] The Herfindahl index is a conventional structural indicator of the level of concentration in an industry. It is defined as the sum of the squares of the market shares of the 50 largest firms (or summed over all the firms if there are fewer than 50) within the industry. A HHI index below 0.01 (or 100) indicates a highly competitive index, a HHI index below 0.15 (or 1,500) indicates an unconcentrated index, between 0.15 to 0.25 (or 1,500 to 2,500) indicates moderate concentration, while a HHI index above 0.25 (above 2,500) indicates high concentration in the industry.

pass securities underwriting and trading, fund management, derivatives trading and general insurance. This expansion coincided with a period of significant growth in securities markets and the markets for foreign exchange and derivatives. It must be highlighted that on aggregate, UK banks' balance sheets account for more than 500% of annual UK GDP, a development that occurred mainly in the 2000's.

Looking at common trends existent in both countries during the last years of our sample, we note the significant credit expansion, as the level of loans to loss provisions increased considerably. One could argue that the signs of the financial turmoil were becoming apparent. Indeed the six largest banks in both countries in the end of 2011 accounted for more than 80% of each country's financial system.

A special feature of our study is the period that is being covered, which is one of the largest of all surveys that have been elaborated in both financial systems. The number of banks that we examine in our study changes during the sample period in both countries. This occurs specifically in Greece due to many M&As that took place in the end of the 90's. The observed wave of mergers and acquisitions was triggered primarily by the willingness of the small banks to obtain a higher market share and secondarily by the privatization process which was initiated by the government, in line with the second Banking Directive. At the end of 2011, the Greek banking system was dominated by six leading large banks in terms of assets, deposits and loans (Ethniki bank – also known as National bank of Greece, Alpha bank, Eurobank, Piraeus bank, Emporiki bank- also known as Commercial bank and Agricultural bank)[23], which altogether held 74.6 per cent of the market share, a figure higher than the average European concentration ratio

[23] In the Greek banking sector a bank is classified as "large" if it holds total assets above 20 billions in euro in 2011.

calculated by the market share of the five largest banks in each country (CR5). This stands at 59.6 per cent for the 27 countries members of the European Union (Greece has 72.0 per cent) and 58.1 per cent for the 17 countries members of the European Monetary Union (European Central Bank, 2011). Turning to the UK banking sector, despite the fact that the market is dominated by four dominant financial institutions (Barclays bank, HSBC bank, RBS bank, Lloyds bank) is less concentrated than the Greek one.

In Tables 3.3.a, 3.3.b and 3.4.a, 3.4.b, we report representative figures of the UK and Greek financial institutions used in both our samples respectively. More specifically, tables 3.3.a and 3.3.b offer an overview of some important banking indicators of the UK and Greek banking sector for the whole period of our study, whereas tables 3.4.a and 3.4.b report an insight on the UK and Greek financial intermediaries for each year of our sample.

3.6 Empirical Results

3.6.1 Historical M&As - Liquidity Creation

Tables 3.5.a and 3.5.b display the empirical findings for UK and Greece respectively. We find a strong empirical evidence of increased liquidity that is created one year after almost all existing M&A activities that have taken place in both banking systems. To be more precise, in the UK banking system our results highlight that in 89.3% of the cases the liquidity that is created by the new financial entity one year after the consolidation process is higher than then liquidity of the proforma bank[24] one year before the M&A activity occurs and specifically it is increased on average by 17.51%. The aforementioned tendency is amplified in a greater scale when we examine the Greek banking sector where the results indicate that liquidity is increased on average by 41.49% one year after the consolidation process. This finding is unequivocally confirmed for all the M&As that have been completed throughout the whole sample period for Greece. Taking a closer look into the characteristics of the involved UK financial institutions, we highlight the fact that despite the low frequency of historical M&As which have been completed by large UK banks compared to the consolidation process that UK building societies consummated, the former are those who create the highest level of liquidity. It is worth mentioning that the cases of consolidation which occur during the years of the financial crisis are the ones which exhibit the biggest positive difference between the two year interval. The latter is of crucial importance as it signals the potential liquidity gains which can be exploited during periods of economic downturns, since problematic financial institutions in terms of liquidity could be able to take advantage of the synergies and cost benefits that result from a consolidation process producing higher liquidity and thus additional credit channels in the economy. Another interesting feature is that financial institutions with multiple M&As within the same year, create higher level of liquidity compared the those which are involved in single M&A activity within a year. Last but not least, specifically for the cases of mergers where all involving financial intermediaries continue to exist[25], there is strong empirical evidence that on average not

[24] Proforma bank consists of the acquirer and the target one year before the M&A occurs.

[25] In the case of an acquisition one financial institution takes over another one and establishes itself as the new owner. Consequently, from a legal point of view, the target financial institution ceases to exist.

only the acquirer but the target financial institution as well increases considerably its level of liquidity one year after the merger is completed compared to one year before. Turning our attention to the Greek banking sector, the results indicate, as in the case of the UK banking sector, that greater liquidity creation is observed one year after the large in size Greek banks complete their M&As activities compared to the consolidation among the smaller banking institutions. Moreover, we highlight the same positive relationship between the number of multiple M&A by the same financial institution and the level of liquidity creation as in the UK banking system.

Robustness Issues

In order to increase the precision of our inferences, we employ two additional ratios which represent two of the most popular liquidity indicators highly used by bank managers and practitioners in supranational institutions. Specifically we use:

i.)

$$liquid1 = \frac{Liquid\ Assets}{Total\ Assets} \tag{3.6.1}$$

ii.)

$$liquid2 = \frac{Liquid\ Assets}{Customer\&Short\ Term\ Funding} \tag{3.6.2}$$

Apart from the wide use of both of these ratios another reason that motivates us to use especially those two is the fact that they compute the liquidity of a financial institution in a different way compared not only to Berger and Bouwman's (2009) preferred measure but among each other as well. The first ratio specifically captures the 'absolute' asset liquidity, since it reflects the percentage of the total assets whose sale can provide instant liquidity in times of need. On the contrary, the second ratio apprehends the 'relative' asset quality, since it relates liquid assets to liquid liabilities. It is known as a deposit run off ratio since it represents what percentage of customer and short term funds could be met if they were withdrawn suddenly. In tables 3.6.a and 3.6.b we present for UK and Greece respectively the differences among the three liquidity measures for each specific historical M&A activity. Since the two additional measures are expressed as a ratio, it would be wrong if we add the liquidity of the acquirer and target in time $t-1$ and compare it with the level of liquidity of the new financial entity in time $t+1$ for each one of the liquidity measures respectively. Precisely, regarding the preferred measure of Berger and Bouwman (2009) (i.e. catfat), we display the difference in liquidity creation between the new financial entity in time $t+1$ compared with the joint liquidity of the acquirer and target in time $t-1$, while as far as the two ratios are concerned, we display the difference in liquidity creation between the new financial entity in time $t+1$ compared to the individual level of liquidity of the acquirer and target in time $t-1$ for each respective ratio. The results displayed in tables 3.6.a and 3.6.b highlight the fact that in both countries the three different measures of liquidity produce similar pictures in favour of the tendency of increased liquidity for the new financial entity one year after consolidation process compared to the proforma bank one year before. We demonstrate that the three different measures of liquidity exhibit at least a 80% degree of robustness among their findings and for some cases we report a 95% of precision.

Now we examine the handful of occasions where we notice a decrease in the two liquidity ratios in time $t+1$ compared to time $t-1$. The results reveal that in both countries the foregoing occurs fairly equal for both acquirers and targets. As far as the acquirers are concerned, it seems the two liquidity ratios decrease in $t+1$ for those financial institutions which are involved in multiple M&As in the same year, while as far as the targets are concerned, this occurs for those credit institutions which are small in size and which are involved into a consolidation process with small in size acquirers as well. This is in line with Berger and Bouwman (2009) who note that large banks are the ones to demonstrate increased liquidity after the M&A activity. Furthermore, we notice in the Greek banking sector that the occasions where each liquidity ratio decreases in time $t+1$, either concerning the acquirer or the target, are exactly the same, while we cannot identify the same pattern in the UK banking sector.

Nonetheless, each liquidity ratio contains different specific information about the financial institution and someone that examines separately each liquidity ratio cannot extract robust inferences regarding the liquidity position of the financial institution. To be more explicit, let's assume two banks have the same level of loans to deposits but one has stable sources of funds whereas the other one doesn't. Someone then could jump to the conclusion that both banks have the same position in terms of liquidity. Nevertheless, neglecting the liquidity risk can contaminate our inferences since the bank with fixed sources of funds faces considerable less liquidity risk than its counterparty. Thus, we investigate in how many of these limited M&As cases which result into a decreased liquidity ratios in time $t+1$ compared to time $t-1$ in both countries, the liquidity decrease appears simultaneously for both ratios as far as either the acquirer and/or the target is concerned. In tables 3.7.a and 3.7.b we provide detailed information for each historical UK and Greek M&A activity respectively, for all three different liquidity measures and for both the acquirer and target regarding the two conventional in the literature measures of liquidity. We notice that this occurs in 12 occasions for the UK and 8 for Greece. If we conduct the previous investigation but this time in order to check how often the aforementioned occurs not only for both ratios simultaneously but for both acquirers and targets of each specific M&A as well, we find that it happens in just one occasion and specifically in the UK banking sector. Consequently, this amplifies considerably the degree of precision of our conjectures which indicate that in both countries, both the acquirer and the target benefit in terms of liquidity one year after they have been involved in an M&A activity.

3.6.2 Historical M&As - "Financial Fragility-Crowding out Hypothesis" vs "Risk Absorption Hypothesis" and "Deposit Insurance Hypothesis "

Tables 3.8.a and 3.8.b display the empirical findings for the UK and the Greek historical M&As. There is strong empirical evidence resulting from the regression equations of the Pana et al. (2010) model, in favour of the "Financial fragility-crowding out" hypothesis in both countries indicated by the negative, statistically significant coefficient of the bank capital variable. Nonetheless, this finding is common in both banking systems only as far as the small acquirers are concerned and it is supported throughout all the sample only in the Greek banking system. This finding is in line with Berger and Bouwman (2009), who use theories of Diamond and Rajan (2000, 2001) and Gorton and Winton (2000) to justify it. To be more precise, on one hand the former paper states that small banks deal more with entrepreneurial-type small businesses which require close monitoring, while the latter paper highlights that capital may "crowd out" deposits since small banks tend to raise funds locally. In addition, empirical support is found in both banking systems regarding the deposit insurance hypothesis. Specifically in line with Pana et al (2010). we find that banks with high level of insured deposits complete M&As which result in an increase of the level of liquidity that they create, at least in the short run. Notwithstanding, as in the case of the two aforementioned conflicting hypotheses, the results hold only for the small in size acquirers who got involved in the historical consolidation process. This finding is partially in line with Fungacova et al (2010), whose findings suggest that implementation of deposit insurance reduces the positive impact of capital on liquidity creation suggested by the "risk absorption hypothesis". Nonetheless, we highlight that we found support of the aforementioned statement only for the small in size acquirers. As far as the 'relative size' of the involved institutions is concerned, once again the results suggest that in both banking systems the higher this ratio the higher the liquidity created one year after the M&A activity took place. This is apparent in the whole sample and in both large and small in size UK acquirers, while we report the same evidence for the whole sample and the small Greek acquirers. This finding for both countries is line with Berger and Bouwman's (2009) findings who indicate that financial institutions which were involved in recent M&As which were large (both the acquirer and the target), account for most of the industry's overall liquidity in that specific year.

On the contrary, there is a considerable deviation among both countries' empirical findings concerning the ownership of the involved financial institutions in the consolidation process . To be more specific, the

Greek M&As who are completed by private credit institutions result in a higher level of liquidity creation in time $t+1$, whereas there is no statistically significant evidence of same in the UK banking sector. This does not come as a surprise, as the vast majority of the financial institutions are privately owned. Last but not least, we turn our attention to a second set of regressions which include an additional indicator of bank's ability to absorb risk; the bank-revenue diversification measure (Stiroh 2004). Albeit the establishment of a nonlinear relationship (i.e, $HHI_{REV}\hat{}2$) between the difference in liquidity creation around M&As and the diversification of the acquirer's revenue stream, the empirical findings are controversial among each country (i.e, HHI_{REV}). On one hand, for the UK banking sector, we report that for the whole sample and large acquirers, revenue diversification did not enhance the new financial entity's ability to absorb any risk resulting from the consolidation process. The opposite holds only in the case of small UK acquirers. On the other hand, we find a positive relationship between the level of the acquiring bank's revenue diversification and the liquidity creation of the new financial institution in time $t+1$ for the Greek banking sector. This holds for both the whole sample and large acquirers. The aforementioned conflicting results, can be justified by an 'inverted U-shaped' relationship between risk and diversification that has recently been proposed in the literature (Demirguc-Kunt and Huizinga, 2010). On a preliminary level, a degree of diversification in a bank's products and services enables the financial institution to absorb risk, since its revenue derives from different sources. Nonetheless, the recent financial turmoil revealed that if banks' revenue is highly depended on non-traditional banking activities (which follow a non-interest revenue stream), then the banks' liquidity risk is greater. Since the large UK financial institutions follow a more sophisticated Universal type of banking with more complex non-interest revenue activities than their Greek counterparties and the small UK banks, is why we find evidence of counterproductive consequences in terms of 'liquidity creation' resulting from their intense revenue diversification process.

Robustness Issues

Similarly to the previous subsection, in order to test the sensitivity of our empirical findings, we conduct two additional robustness tests. First we perform the same regression analysis where this time instead of the independent variables deriving just from acquirers, they derive from both acquirers and targets (i.e., proforma bank) in time $t-1$. The results for the UK and the Greek banking sector are displayed in tables 3.9.a and 3.9.b respectively. Second, it is acknowledged that the lagged value of bank's equity capital, which is the key variable of interest in defining which hypothesis our data supports, is also included in the dependent variable. For this purpose, we re-estimate our model by excluding equity capital from the calculation of our dependent variable (i.e. 'catfat', the preferred measure of liquidity of Berger and Bouwman (2009)). We conduct this analysis by using both the acquirers' and proforma's values for our independent variables. As before, tables 3.10.a and 3.10.b, and 3.11.a and 3.11.b demonstrate the empirical evidence for both countries' historical M&As where the independent variables derive from the acquirers and proforma bank respectively. As far as the former robustness control is concerned, the primordial difference in the UK banking system is that we don't find support anymore of the deposit insurance hypothesis in the small sized acquirers. This can be explained by the fact that the size of the proforma bank is not considered to be 'small' anymore as it was the acquirer's in the first round of the regression analysis. While the main difference in the Greek banking sector is that now, not only for the whole sample and the large acquirers but for the small as well, there is a positive relationship of the 'relative size' variable and liquidity creation around M&As. We use the same reasoning as in the previous difference in the UK M&As and pointing out, that probably the Greek proforma institutions are not considered as small financial institutions anymore and demonstrate a same pattern regarding their relationship with the specific variable as the large acquirers do. As far as the latter robustness control is concerned, the results across countries and across different methods in the measurement of the independent variables used in the regressions unequivocally remain unchanged. Consequently, from the two aforementioned robustness tests and the derivation of various sub categories for each one of them, we can be confident that the inferences in both countries regarding the two conflicting hypotheses (i.e. "Financial fragility-crowding out" and the "Risk absorption") and the relationship between the 'deposit insurance' hypothesis and the liquidity creation around M&As were extracted with a high degree of confidence.

3.6.3 Recent & Prospective M&As - "Cost Efficiency-Liquidity Creation Hypothesis" (CELCH)

In tables 3.12.a and 3.12.b we present the results of all the cases of potential and recent/potential M&A activity for the UK and Greece respectively. One of the most intrinsic finding is that in both banking sectors the vast majority of the potential combinations of M&A would have contributed considerably to the enhancement of the 'liquidity-efficiency' relationship, had they occurred in the pre-crisis period. Precisely, the empirical evidence displayed in tables 3.12.a and 3.12.b reveals that in more than 99.4% and 98.1% of the UK and Greek hypothetical banks' M&A scenarios respectively cost efficiency and liquidity creation would increase. As far as the post-crisis period is concerned, the results highlight a crucial difference between the two countries. In the UK banking sector, we report a small decrease compared to the pre-crisis period where approximately 87% of the cases of potential consolidation activity would be beneficial for the economy in terms of efficiency and liquidity. However, the difference is much higher in the Greek banking sector between the two periods, where only 43% of the total hypothetical scenarios could have possibly created additional credit channels in the economy through their enhanced cost efficiency. Overall, in both banking systems for both periods, hypothetical consolidation activity among large financial institutions seems to create the highest cost efficiency benefits which could result in increased provision of liquidity to the economy which is in line with Berger and Bouwman (2009) and Pana et al. (2010). Noteworthy is the fact that for both the UK and the Greek banking system in the pre-crisis period, the same hypothetical M&A combinations produce 83% and 93% higher efficiency gains respectively compared to the years following the crisis. This illustrates the detrimental impact that the recent financial turmoil had on both countries' banking system stability.

Taking a closer look at the empirical findings concerning the UK banking sector, we highlight the fact for most of the cases that contribute successfully to the 'cost efficiency-liquidity' relationship, the combinations that consist of three banking institutions are those which produce the higher positive differences compared to those that are constituted by two credit institutions. Precisely, it seems that the 'big-four' of the UK banking sector (Barclays, HSBC, Lloyds and RBS) create the most cost-efficient combinations of potential M&A activity which could result in increased liquidity creation, with Barclays bank producing the highest during the pre-crisis period and Lloyds bank during the post-crisis period. On the contrary, potential M&A combinations among small banks do not seem to improve their position regarding their cost efficiency and liquidity creation. This is more frequent in M&A combinations that Co-operative bank, UBS bank and AIB bank create and in certain occassions the ones of Sainsbury's bank as well, regardless of whether they involve larger or smaller banks. This is in line with recent empirical findings (Hughes and Mester 2013) who find evidence of higher scale economies for large USA banks compared to small size banks. Thus, increased size and consequently increased market share deriving from potential M&A activity can be proved essential in exploitation of economies of scale which will enhance the bank's cost efficiency and produce as an aftermath increased liquidity creation.

Turning our attention now to the Greek banking sector, our empirical evidence reveals a similar positive relationship between size and the CELCH for the pre-crisis period, as in the UK banking sector. The 'big four' of the Greek banking sector (National bank of Greece, EFG Eurobank, Alpha bank, Piraeus bank), seem to produce the highest 'cost efficiency-liquidity creation' gains with National bank of Greece being the first in this list. This holds when we examine them in both their previous individual formation and the current systemic shape resulting from the recent consolidation process (i.e. including for each one of them all the financial institutions they acquired). Nonetheless, the results are mixed as far as the post-crisis period is concerned. To be more precise, we report strong evidence of decreased 'cost efficiency-liquidity creation' produced by potential M&A combinations for all the four new 'systemic' cornerstones of the Greek Economy. Precisely, the new Eurobank and the new Piraeus bank seem to generate the most 'cost efficiency-liquidity' losses in the aftermath of the global financial meltdown. This holds in both banks for more than 86% of all their potential combinations of consolidation activity after their recent M&A whereas this percentage is reduced to 70% for both the new Ethniki bank and the new Alpha bank. On the contrary, our empirical examination indicates that all the big-four of the country's banking system in their pre-systemic shape or during their systemic formation (i.e., if they hadn't acquired specific financial institutions), would produce higher 'cost efficiency-liquidity levels. To be more explicit, we show evidence of negative impact in liquidity creation resulting from the acquisition of Proton bank and of ATE bank and Geniki bank from Eurobank and Piraeus bank. Unequivocally, the last points cast doubts on the true motivation from the point of view of the Greek government, the European Financial Stability Fund (EFSF) and the Hellenic Financial Stability Fund (HFSF) and the executive boards of the financial institutions that were involved in the recent wave of consolidation in Greece. To be more explicit, we cast doubt on the selection process followed by the foregoing policy makers and involved banks in deciding which financial institution will be the acquirer and which the target, with respect to the true social benefits stemming from the consolidation process. As far as the potential consolidation activity between each of the four new systemic banks with the remaining financial institutions that have not been involved in the recent wave of consolidation (Attica bank, Panellinia bank, Pancretan Co-operative bank, Aegean bank) is concerned, we found a positive impact in liquidity creation from the potential combinations that Aegean bank and Pancretan Co-operative bank create, while negative empirical evidence is found in most of Attica bank's and Panellinia bank's M&A scenarios with the new 'big-four'. This holds when we examine the hypothetical consolidation activity among the remaining non-systemic banks, where 'cost efficiency-liquidity creation' gains is reported only in 20% of the potential M&A scenarios, all being constituted by Aegean bank and Pancretan Co-operative bank and in one case Panellinia bank is involved as well. Overall, after a thorough examination of all the potential M&A scenarios that we examine in the Greek banking sector, the consensus inference that we extract is that the higher the number of the banking institutions involved in a hypothetical consolidation activity, the lower are the 'cost efficiency-liquidity creation' gains.

On the whole, we argue that the main reason for reporting such a considerable decrease of the Greek banks' potential consolidation cases which could be proved beneficial for the economy via their enhanced efficiency and thus enhanced liquidity, might be due to the important 'haircut' (i.e. Private Sector Involvement) in the value of the government bond that these institutions hold in their financial accounts. Of course, maybe we would find a similar 'negative' picture in terms of liquidity creation in the post crisis period in the UK banking sector, had we examined potential M&A combinations consisting of more than three credit institutions and/or had we selected smaller in size in terms of assets, loans and deposits financial intermediaries. Nevertheless, for both banking systems and for both periods, we report strong empirical evidence of potential consolidation activities among specific banking institutions that could ameliorate the social well-being via banks' efficiency and liquidity headway. As far as the Greek economy is concerned, these certain hypothetical M&A scenarios could be proven vital in alleviating the terms of the both 'memorandums' with the 'Troika' and could result in social benefits deriving from softer austerity measures, while the UK economy could have benefit as well, as the BoE might not have to continue in such a great scale its unconventional monetary strategy and the UK economy might had experienced milder increase of its unemployment and especially milder decline of its growth.

3.6.4 Stress test scenario

In this subsection our empirical analysis has a twofold simultaneous scope: on one hand we attempt to investigate the contribution of the successful, in terms of 'cost efficiency-liquidity creation', potential combinations of M&As of UK and Greek banks in the post-crisis period, which we just presented in the previous subsection, to the robustness of the whole banking system in terms of 'liquidity risk' under a PVAR methodology ; while at the same time, we examine the impact of bank cost efficiency on bank liquidity creation and the direction of their causality as well. This, in essence, tests from a different econometric perspective our suggested 'cost efficiency-liquidity creation' hypothesis.

Before going ahead with the panel VAR approach, an essential condition is that all variables included in the system are stationary. With respect to this we run the model in first differences[26] to focus on the dynamics of liquidity creation adjustments and shortrun effects[27]. Additionally, we test whether the main variables of interest are stationary by examining two different panel unit root tests; the ADF and PP type

[26] Remember that the estimate of cost efficiency is expressed by a ratio and its score ranges between the values 0 and 1, thus we keep this variable in levels, as it is by construction stationary.

[27] Another way to proceed would be to test for stationarity variables in levels and if they are found non-stationary, to test for cointegration relationship between variables. The absence of cointegration relationship would justify solely focusing on short-run and using variables in first differences, while the presence of cointegration would call for structural VAR analysis of long-run effects. Our study does not address long-run effects and therefore we directly use variables in first differences.

Fisher Chi-square tests of Maddala and Wu (1999)[28]. All unit root tests are reported in tables 3.13.a and 3.13.b for UK and Greece respectively[29]. The results strongly suggest that all the variables included in the analysis do not follow a unit root process in each potential M&A scenario for both banking systems.

Another important issue before we proceed with the estimation of the panel VAR is is to determine the appropriate lag order p of the right-hand variables in the system of equations. Lütkepohl (2005) suggests to estimate models with different lag orders and then to choose the model with the highest lag order that passes the diagnostic tests. To do so, we utilize the Arellano-Bover GMM estimator for higher order of lags. We use the Akaike Information Criterion (AIC) to choose the optimal lag order. The AIC suggests that the optimum lag order is one, while the Arellano-Bond AR tests confirm this. We included more lags to control for autocorrelation. The Sargan tests provide evidence of lag order one as well.

Impulse response functions and Variance decompositions

Figure 3.2 illustrates the impulse response functions with respect to liquidity creation deriving from the panel VAR system for both the UK and Greek baseline scenario of no bank consolidation activity in the

[28] Due to the fact that we have an unbalanced data, we can conduct either the unit root test of Im-Pesaran-Shin (IPS), (2003) or the Fisher-type unit-root tests. Nevertheless, the IPS unit-root test requires at least 10 observations per panel, which is not the case in our study. Additionally, Maddala and Wu (1999) favour Fisher-type unit-root tests as they are more powerful in distinguishing the null and the alternative hypotheses and cross-sectional correlation among variables.

[29] We test for a unit root in each potential M&A scenario for both countries. However for brevity purposes, we report only the two common in both countries baseline cases where no bank consolidation activity has been held in the sector.

sector and the additional baseline scenario including the recent wave of Greek banks' for each of our shocks. First and foremost, looking at figure 3.2 we note that financial and bank shocks seem to be the most persistent on liquidity creation. Precisely as far as the former is concerned, in all three rows a one standard deviation shock of the three month Treasury bill rate on liquidity is positive and statistically significant, while the effect of the real effective exchange rate is rather innocuous.

Comparing the two countries' banking sectors, we see that the effect of a change in the level of policy rates on liquidity is more persistent in the Greek banking sector where it takes about two years to lose its significance, while it requires one and a half years approximately in the UK banking sector. Looking at the two Greek baseline scenarios, noteworthy is the fact that its effect is slightly bigger in the systemic formation of the banking sector. As far the bank shock is concerned we highlight that both its sources; the cost efficiency and total problem loans variables, create a positive and statistical significant impact on liquidity creation. The fact that liquidity has a response in the same direction on both sources of the bank shocks confirms that there is no violation from a theoretical perspective when we characterized the average of both cost efficiency and total problem loans variables as a bank-specific shock. Since, if this common direction did not exist potentially the two different bank shocks could be cancelling out each other. As far as the shock on the non-performing loans variable is concerned, we note that it is always statistically significant and as before more persistent in the Greek banking sector with a statistically significant time-period difference of about half a year more than the UK one. Additionally, the impact is once again bigger in the state after the recent M&As in the Greek banking system. The fact that a positive one standard deviation bank-specific shock of cost efficiency on liquidity triggers a positive and statistically significant (at least for the formation including the recent consolidation activity as far as the Greek banking sector is concerned) response in both countries, is of major importance for two reasons: First and foremost, we provide for the first time in the literature an empirical insight about the impact of efficiency on liquidity creation and its sign as well. Second, the fact that the response of liquidity is positive provides an empirical proof of the positive impact of cost efficiency on liquidity creation that we based our assumptions in the previous part of our empirical analysis and sets a solid foundation for our proposed "*Cost Efficiency - Liquidity Creation Hypothesis*". Furthermore, we highlight that the cost efficiency bank-specific shock on liquidity creation takes at least six months less to be absorbed in the UK than the Greek banking sector. An interesting finding is that this impact seems to be of minor importance in the Greek banking system without its current systemic nature. This may amplify our belief that the specific recent Greek banks' M&As did not contribute to the amelioration of the 'proforma' banks' cost efficiency and in extend to the overall sector's cost efficiency which could enhance liquidity creation[30]. Lastly, we note that in both countries and in both formations of the Greek banking system, the response of liquidity to a macroeconomic shock exhibits a rather oscillating pattern which reflects a downwards movement during the first periods and an upward direction thereafter.

Further, we want to examine the impact of macroeconomic, financial and bank shocks to the robustness of each country's baseline sce-

[30] As a robustness check, different ordering of the variables was considered and the impulse responses computed using the 'generalised impulse' function described in Pesaran and Shin (1998). This method constructs an orthogonal set of shocks that does not depend on the variable ordering. The results remained unchanged.

nario of the banking sector with respect to its cost efficiency. Figure 3.3 displays the response of cost efficiency for all three categories of shocks. One of the most intrinsic differences is that all shocks are persistent on cost efficiency. A finding of utmost importance is that a closer look at the bank shocks (i.e., liquidity creation, non-performing loans) reveals that cost efficiency is decreasing after innovations to each one of those two. From this we extract two important inferences. First, non-performing loans decrease cost efficiency, thus financial institutions seek to find strategies to confront with this issue. According to the banking theory, a successful strategy with respect to the issuance of loans is to reduce information asymmetries and improve their screening process of their borrowers. Thus, we show that we establish an additional empirical proof in line with the proposed "*Cost Efficiency - Liquidity Creation Hypothesis*". Second, albeit that before we report an increase on liquidity creation after a positive shock of cost efficiency, now, we highlight a decrease of cost efficiency when there is a positive bank-specific shock to liquidity. At first sight, this result might look odd; nevertheless, it is in line with recent studies highlighting that 'excess' liquidity creation could distort the stability of the banking sector by triggering bank failures (Fungacova et al., 2013). To put it differently, despite the fact that liquidity creation is desirable in the economy, since it increases the available credit channels and consequently, it enhances investment and growth, however, beyond the 'optimum' level it increases the likelihood of distress of a bank and the severity of losses is exacerbated as assets are liquidated to meet liquidity demands (Allen and Gale 2004). At this point it would be interesting to pinpoint the direction of causality among liquidity creation and cost efficiency which is quite challenging due to the conflicting direction of the response of each variable to a standard deviation shock of the other. An important difference between these two shocks is the fact that the innovation of cost efficiency becomes apparent on liquidity creation after one period, whereas the shock of liquidity creation on cost efficiency has an instantaneous negative impact on cost efficiency. Additionally, we highlight that the persistence of liquidity creation's innovation on cost efficiency is twice as large as the cost efficiency's shock on liquidity. Taking into consideration the last two points, we argue that the direction of causality among these two variables of interest is found to be stronger from liquidity creation towards cost efficiency than the reverse impact. Further, as before, the fact that the sign of the response of cost efficiency is the same in each one of the shocked bank variables; it means that there is no violation from a theoretical perspective when we characterize as a bank shock (on cost efficiency) the average innovation of both liquidity creation and total problem loans variable. It is worth mentioning that that the shock of non-performing loans on cost efficiency is statistically more significant in the UK than in the Greek banking sector without any recent consolidation activity; though its significance it is apparent only for a short period[31]. This result may reflect the higher cost efficiency scores of the Greek banking sector than the UK one (European Banking Federation (EBF) report 2012). The liquidity creation shock though is more persistent in both formations of the Greek banking sector compared to the UK. Moreover we highlight that the liquidity creation shock is more persistent in the systemic nature of the Greek banking sector which highlights the vulnerability of this recent formation on potential liquidity shocks. As far as the macroeconomic shock is concerned we note that an innovation to GDP will increase cost efficiency. In addition, the shock is clearly more persistent in Greece at

[31] The literature on IRFS highlights that when the confidence interval of IRFs is wide, one needs to treat the results with caution.

least for an additional six-month period. Last, as far as the financial shock is concerned, we note that it is highly persistent in both countries and statistically significant in both its sources; policy interest rates and real effective exchange rate. However, once again we can see that an innovation on the policy interest rates will dissipate quicker in the UK than the two baseline conditions of the Greek banking system.

To shed more light into our analysis, we also present variance decompositions (VDCs), which show the per cent of the variation in one variable that is explained by the shock in another variable. In tables 3.14 and 3.15 we report the total effect accumulated over 10, 20 and 30 years for all the baselines conditions of the UK and the Greek banking sector with respect to liquidity creation and cost efficiency respectively. The empirical evidence in table 3.14 insinuates the importance of the bank shocks and specifically the aggregate level of non-performing loans in explaining the variation of liquidity creation. This empirical finding amplifies further the theoretical intuition of the "*Cost Efficiency - Liquidity Creation Hypothesis*", as it highlights the importance of a bank manager to reduce the level of NPL since it distorts the its cost efficiency level. This results to reduce information asymmetries and thus increase the banks liquidity creation via increasing the weight of illiquid assets. To be more precise, close to 11,6% and 13,6% of liquidity creation's forecast error variance after thirty years is explained by the level of 'bad' loans in the UK and Greek banking sector without any potential bank consolidation activity. We highlight that the aforementioned percentage increases and reaches a level of 20% in the recent systemic nature of the Greek banking sector. While the second source of a bank-specific shock, the cost efficiency variable, explains only about 4% for the UK and 1% for the Greek banking in its pre-systemic formation of a potential deviation between the forecasted and the true values of liquidity creation thirty years from now. This percentage becomes even smaller than 1% after the creation of the four systemic cornerstones of the Greek economy. Macroeconomic factors play a more important role in explaining variations of liquidity creation over all the forecasting horizons in the UK rather than in the Greek banking sector, though this is less than 2%. As far as the financial indicators are concerned, the empirical evidence shows a common pattern in both countries. Specifically the level of the policy interest rates accounts for approximately 4% of the forecast error of the level of the liquidity creation level of the whole banking system in both countries after thirty years, while the impact of the effective exchange rate is innocuous.

Turning now to table 3.15 and the variance decompositions with respect to cost efficiency, a noteworthy difference is in fact that liquidity creation accounts for a considerably larger percentage of the deviation from the true future values of cost efficiency, that the reverse relationship. This holds in both countries and in all specifications. This finding is of crucial importance as it amplifies our belief that the direction of causality from liquidity creation to cost efficiency is stronger than in the opposite direction. An additional remarkable difference is that both sources of the bank shock explain to a greater extent any deviations between the forecasted and the true values of cost efficiency in the UK banking system than in the Greek one with or without the recent wave of consolidation. This might be justified from the fact that the UK banking sector is more sophisticated and at the same time more complex than the Greek one, and consequently the future score of cost efficiency depends more heavily on bank-specific elements. As far as the macroeconomic and financial shocks are concerned, we note their contribution on future deviations of cost efficiency scores is larger in the Greek banking sector than in the UK, and specifically in its recent systemic formation. This finding increases our concerns with respect to the social benefits deriving from the recent consolidation activity of the 'big-four' Greek banks.

On the whole, after the impulse response and the associated variance decomposition analysis, we argue that both the liquidity creation and cost efficiency of the UK banking sector seems to be more robust than both the pre and post systemic nature of the Greek banking sector, when hypothetical adverse, macroeconomic, financial and bank-specific conditions occur in the economy. In addition we argue that the direction of causality among these two variables is stronger from liquidity creation to cost efficiency than the reverse impact. A closer look at these three different in nature shocks and their respective components, reveals that bank-specific conditions and precisely the level of non-performing loans in the sector is what has the biggest effect on liquidity creation and explains, in a considerably larger extent than the rest variables in the panel VAR system, deviations of the forecasted values of liquidity creation from its trues levels. Nonetheless, we note that all three types of shocks are important and more persistent with respect to cost efficiency. As far as the Greek banking sector is concerned, noteworthy is the fact that the impact of macroeconomic, financial and bank shocks is more persistent in its recent systemic formation. This finding amplifies our scepticism from the previous subsection of our empirical analysis regarding the social economic benefits of the recent wave of banks' M&As. For this reason, we investigate further the stability of the UK and Greek banking sector regarding their liquidity creation in both baseline scenarios against hypothetical macroeconomic, financial and bank unexpected innovations by exploring the behaviour of specific potential banks' consolidation activity.

Recent & Prospective M&As - Half life comparisons

The following pairs of tables - 3.16.a, 3.16.b; 3.17.a, 3.17.b and 3.18.a, 3.18.b - demonstrate those UK and Greek potential combinations of banks' M&A that achieve to create the necessary dynamics for the whole banking system to be able to produce greater stability in terms of its 'liquidity creation', than a banking system without the presence of those specific hypothetical banks' consolidation activities, after a future macroeconomic, financial and bank shock respectively. Precisely, in these tables we present all the potential M&A cases which form a banking sector whose half-life and total effect after each shock is less than the respective ones which derive from a banking sector without any consolidation activity, and/or without any further consolidation activity as far as the Greek banking sector is concerned.

It is noteworthy that potential consolidation activity among the largest banks in each country creates the most robust banking sectors with respect to their liquidity creation. A result which amplifies previous findings in our study concerning the high levels of liquidity creation, the enhanced cost efficiency and the after-effect social gains as well that is produced after M&As among large banks. Another interesting finding common in both countries, is that the time needed for half of the effect of each shock to dissipate and its total effect on the whole banking system's liquidity creation, is less when potential consolidation activity consists of three rather than two financial institutions. Nonetheless, we find conflicting evidence for most of the M&A cases in both countries where more financial intermediaries are involved in a consolidation activity. This finding comes is line with recent debates from both an academic and a practitioner's perspective, regarding the optimal size of financial institution and whether it is 'too-big-to-fail'

(TBF) or ‘too-big-to-save’ (TBS), since it has been shown that the structure of a financial system affects the transmission of business cycles shocks in the economy and vice-versa. Specifically, after the recent financial crisis, the Financial Stability Board (FSB) has created a list of 29 global systemically important banks (G-SIBs) whose "distress or disorderly failure, as a result of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity" (FSB November 2011). Tables 3.19.a and 3.19.b, display these UK and Greek potential banks’ consolidation activities respectively that constitute a banking sector whose liquidity creation is found to be more robust in all three different shocks, than the current UK and Greek banking sector in each formation. Additionally, from these aforementioned M&As, we construct all possible hypothetical consolidation scenarios that can occur simultaneously in each banking system and present in tables 3.20.a and 3.20.b in respect to the UK and Greek banking sector. A noteworthy finding is that the vast majority of those ’simultaneous’ M&As scenarios seems to create more robust conditions with respect to liquidity creation of the country’s banking sector than the individual banks’ consolidation scenarios that they consist of. Thus, it seems that the more frequent is the consolidation activity among large and cost efficient financial institutions, the higher is the stability of the banking sector’s liquidity creation. Last but not least, the half-life and the total effect of a macroeconomic shock, is considerably higher than the one of a financial and a bank shock. This result should not come as a surprise, since both theoretical and empirical evidence has demonstrated that business cycles which are determined by fluctuations in macroeconomic factors, such as aggregate output, consumption and income, create conditions whose impact requires adequate amount of time to dissipate.

Turning our attention to each country's banking sector, a noteworthy difference is that both the half-life and the total effect of either three different shocks is considerably less for the UK banking sector. This holds when we compare the UK banking sector's 'baseline' case with either of the two 'baseline' cases of the Greek banking sector. This is a crucial finding, since both banking systems confronted serious consequences of the financial turmoil, nevertheless, it seems that the impact of the crisis was more severe in terms of liquidity in the Greek banking sector. Concerning the UK banking system, the results reveal that HSBC bank and Barclays bank from the 'big four' of the UK banking system and Standard Chartered bank and Santander bank from the remaining banks that we include in our study, create the most robust in terms of 'liquidity creation' combinations of potential consolidation activity, against all three different stress tests that we created. While we find the same empirical evidence for Ethniki bank and Alpha bank from the 'big-four' group of the Greek banking system and for Aegean bank and Pancretan bank as well regarding the group of banks that have not been involved in the recent wave of M&A.

Lastly, as the far as the Greek banking sector is concerned, we compare the two 'baseline' sectors; one that does not include the recent wave of consolidation and its after-effect: the formation of the four so-called 'cornerstones' of the Greek economy and another one which does include all the recent banks' M&A. The half-life and total effect results indicate that in two out of the three different hypothetical stress tests, the Greek banking sector is found to be more robust with its initial structure before 2012, which does not incorporate the series of M&A of the 'big-four' institutions of the sector. Precisely, only in the scenario of a potential financial shock the current formation of the Greek banking sector seems to create these necessary dynamics that allow it to better withstand future tremors in the total level of liquidity that it creates. This finding amplifies our aforementioned concerns regarding the true social benefits stemming from the recent wave of consolidation. Our empirical evidence highlights that the formation of two out of the four cornerstones of the Greek economic recovery, the systemic 'Eurobank' and 'Piraeus bank' doesn't create the most optimum conditions to be able to withstand fluctuations in the level of liquidity that they create after a potential adverse macroeconomic and bank-specific developments. It is important to remember that the primary reason of the recent wave of consolidation in the Greek banking system was the enhancement of liquidity and stability conditions in the economy in an era where the country has been blocked from the international capital markets and their resulting credit channels. With this in mind, the latest (in the time that this study is written) financial report of the Governor of the Bank of Greece (October 2013), notes that there is a negative 3.9 per cent annual change in the total level of credit provided by the Greek financial intermediaries to both public and private sector, while during the same period the total level of Greek bank deposits has been increased by 6.7 per cent. Additionally the report indicates that the interest rate spread in the country has seen increased and reached the level 3,6 per cent, mainly due to reduced deposit rates. Consequently, our findings strengthen our concerns about the effective social surplus, in terms of liquidity which results in the aftermath of the recent wave of banks consolidation.

3.7 Concluding Remarks

The global financial crisis triggered and exposed several fiscal imbalances and large sovereign debts of various developed and emerging economies in an international level. Unequivocally, the European economy constitutes the most representative example of this severe economic downturn, since it experienced its deepest recession since the 1930s, with real GDP following its sharpest contraction in the history of the European Union. That said, a scepticism has been raised regarding the future existence of both the European Monetary Union and the European Union, since there is the fear of the so-called systemic risk and its tremendous contagion consequences being transmitted from different member countries. The UK and Greece, from the beginning of the global financial turmoil, went through deeper recession and slow improvements in competitiveness which had a severe impact on both countries' banking sector solvency and stability since one of its two primordial roles, liquidity provider to the economy, has been severely deteriorated. The impact of banks M&A has raised concerns among policy-makers as to whether these could generate increased liquidity and enhance the stability conditions of the sector.

This study proposes a novel theoretical hypothesis, the so-called "Cost Efficiency-Liquidity Creation Hypothesis" (CELCH), which argues that "cost efficiency" enhancing banks' M&A, can create both increased liquidity and social welfare surplus. An additional novelty of our study is that we provide empirical evidence regarding the direction of causality among these two variables. In this spirit, this is the first study that investigates all the historical UK and Greek banks' M&As in respect to their credit supply and their consequences to social benefits and to loan pricing behaviour. We approach this framework by employing recently developed measures of liquidity creation that account for both on and off balance sheet banks' activities (Berger and Bouwman 2009). Additionally, we exploit on one hand potential social welfare benefits in the UK banking system through potential M&As and we address the question of whether they can reduce the unconventional monetary activities (i.e Quantitative Easing) of the Bank of England. On the other hand, we investigate whether potential M&As can be proved vital in alleviating the terms of the memorandum between Greece and the so-called Troika (IMF, European Commission, European Central Bank), enhancing the real economy, households and firms, with the creation of additional credit channels in the spectrum of a severe country default risk. Further, we conduct a comparative and a forecasting analysis pre-crisis and post-crisis which has major policy implications regarding the trade-off between shareholders' personal gains and society's economic prosperity, that triggers M&A activity. In addition, we examine the impact of the "Deposit Insurance Hypothesis" to liquidity creation and the relationship between capital and liquidity which is expressed by two additional competing hypotheses: "Financial Fragility – Crowding out" vs "Risk Absorption", in the spirit of Basel III, where it is given a major emphasis on liquidity and it is implemented by the introduction of two ratios, namely the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR).

Last but not least, we propose a novel methodology to evaluate and compare the robustness of mergers and acquisitions. The way we achieve that is by the use of a stress test scenario under a panel vector autoregressive (PVAR) model, which enables us to infer major policy implications towards the stability of vulnerable banking systems especially in the era of the recent financial crisis. Thus, we capture in a more appropriate way the impact of adverse macroeconomic, financial and bank-specific conditions and thus we are able to extract unbiased inferences regarding the robustness of the Greek and UK banking sector on liquidity creation, with crucial policy implications in the spectrum of the economic prosperity. Said that, this if the first study which addresses empirically the impact of efficiency on liquidity. This is of extreme importance since the former's enhancement is an explicit policy objective in the Single Market Directive of the European Commission, while the latter is the main driver of the recently implemented regulations on banking supervision under the Basel III Accord. To be able to make precise evaluations and comparisons among the potential M&As cases under investigation we employ recent in the literature half-life measures of the associated impulse response functions, in order to examine thoroughly the robustness and the total effect on liquidity creation of the UK and Greek banks' hypothetical consolidation activities, due to adverse macroeconomic, financial and bank-specific developments.

We report increased liquidity that is created after the vast majority of historical consolidation activity in both countries. Additionally, empirical evidence deriving from these historical M&As, gives support to the "Deposit Insurance Hypothesis" and reveals that both banking systems are in line with the "Financial Fragility – Crowding out hypothesis". These results hold after various robustness checks. Via our proposed "Cost Efficiency-Liquidity Creation Hypothesis" (CELCH), we provide evidence of increased liquidity that is created after potential M&A activity of two and three banking institutions in both the pre-crisis and post-crisis era, though the evidence during the former period is considerably stronger. Large financial institutions seem to create the highest cost efficiency benefits which could result in increased provision liquidity to the economy. This is consistent in both banking systems and for both periods around the crisis. As far as the recent wave of bank consolidation and the creation of the four so-called 'cornerstones' of the Greek economy is concerned, we cast doubts on the decision of the foregoing policy makers and the boards of the involved banks in the selection process regarding the true social welfare benefit of the consolidation process, since the results indicate decreased 'cost efficiency-liquidity creation'.

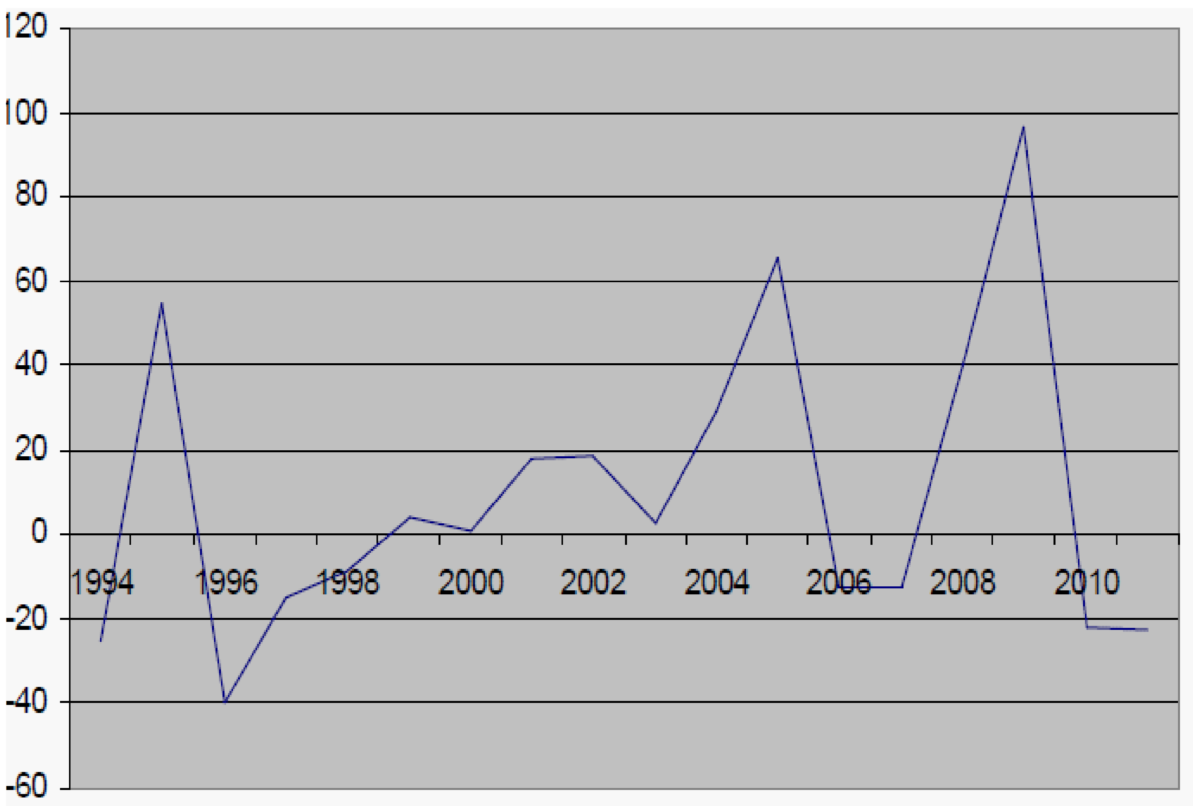
The stress test scenario reveals a positive impact of cost efficiency on liquidity creation and sets a solid foundation for our proposed "cost efficiency-liquidity creation hypothesis". Moreover, the empirical evidence highlights that more robust conditions exist in the UK than in the Greek banking sector with respect to liquidity creation when hypothetical adverse, macroeconomic, financial and bank-specific conditions occur in the economy. In both countries' banking sectors it seems that bank shocks and specifically the level of non-performing loans in the sector are more persistent and account from most of the deviations of the forecasted values of liquidity from its trues levels. Nonetheless, all three types of shocks are found to play an important role for both countries and for all baselines conditions with respect to cost efficiency. In addition, our results highlight that the direction of causality among these two variables of interest is stronger from liquidity creation towards cost efficiency than the reverse impact. Noteworthy is the fact, that the effect of all three different in nature shocks that we stressed the economy is more persistent in the current systemic formation of the Greek banking sector compared to its pre-crisis formation. A finding that raises further concerns towards the social economic benefits of the recent wave of banks M&A. Further investigation regarding potential UK and Greek banks' consolidation activity against the three different in nature shocks revealed that the more frequent is the consolidation activity among large and cost efficient financial institutions the higher is the stability of the banking sector's liquidity creation. While, regarding the Greek banking sector, the half-life and total effect results of adverse macroeconomic and bank-specific conditions indicate the sector was more robust with respect to liquidity creation before its current systemic formation

3.8 Discussion

Our study has some main policy implications in the post crisis era. We argue that additional credit channels in the economy can be created via potential bank-consolidation activity. Nonetheless, according to our proposed "Cost Efficiency-Liquidity Creation Hypothesis", this credit facilitation can contribute to the social welfare only if cost efficiency enhancement is apparent in the 'new' financial entity. However, we note that our proposed PVAR methodology in examining the robustness of a banking system on exogenous and endogenous shocks should be further applied before any police implementation takes place. Specifically, banking systems, not only in EU and EMU area but worldwide such as in US, China and in several emerging economies, should be empirically investigated as well. Additionally, it would be interesting to investigate the impact of 'profit' efficiency on liquidity creation and thus address both standards of economic efficiency on more countries. In this way we can have a more complete view of the overall impact of economic efficiency on liquidity creation.

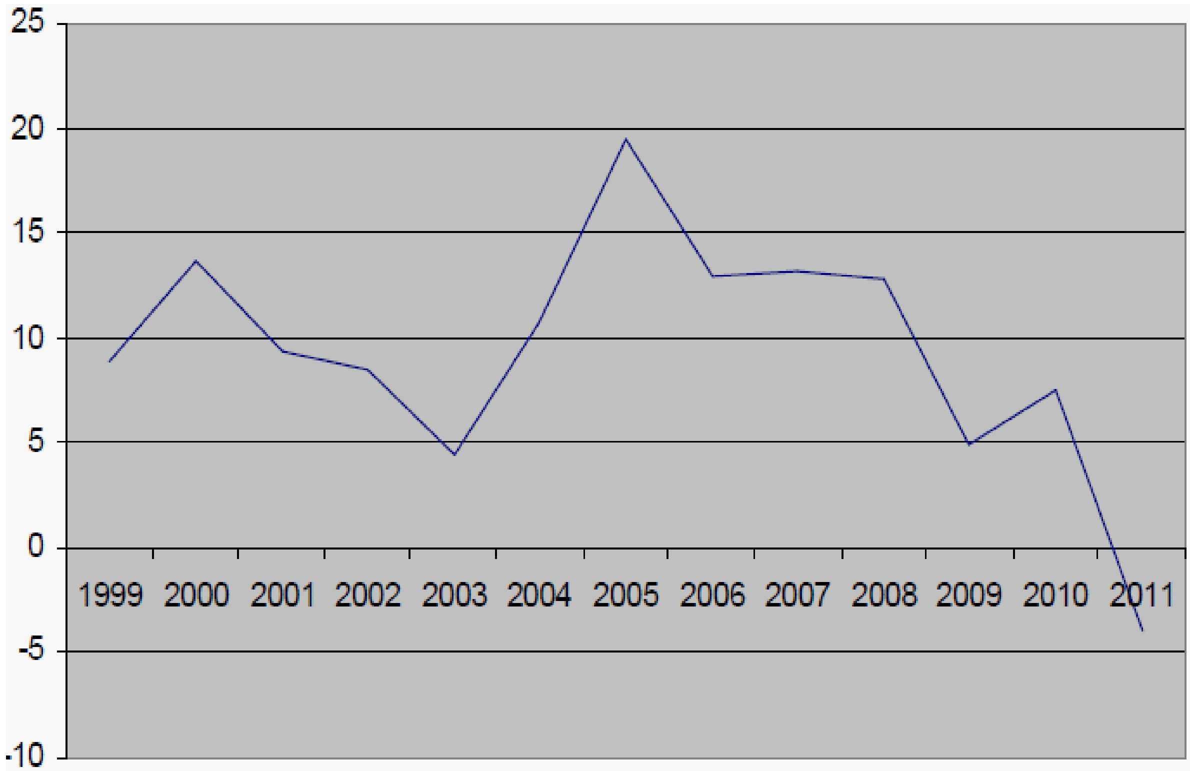
3.9 Appendix

Figure 3.1.a: UK - Growth rate of credit to public & private sector by UK financial intermediaries



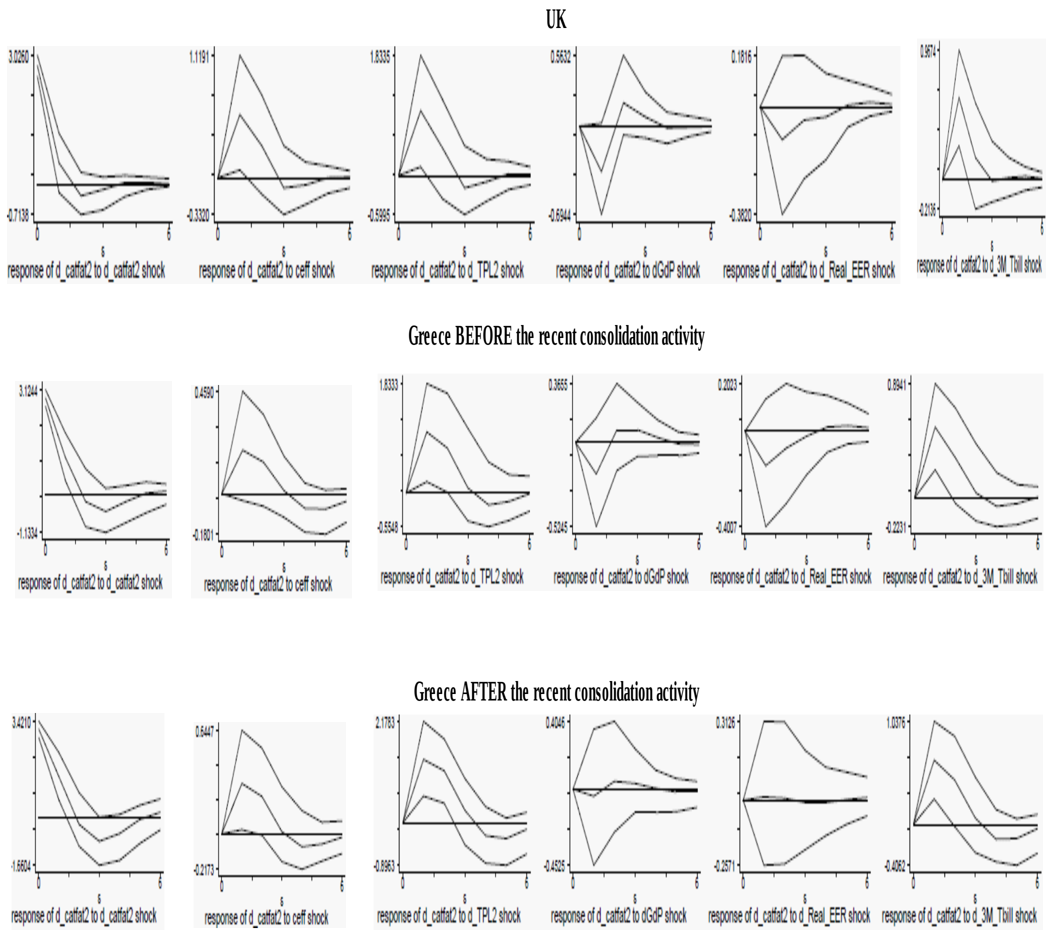
Notes: This figure displays the annual growth rate of the volume of loans and credit facility provided in both public and private sector by the financial intermediaries operating in the UK banking sector.

Figure 3.1.b: Greece - Growth rate of credit to public & private sector by Greek financial intermediaries



Notes: This figure displays the annual growth rate of the volume of loans and credit facility provided in both public and private sector by the financial intermediaries operating in the Greek banking sector.

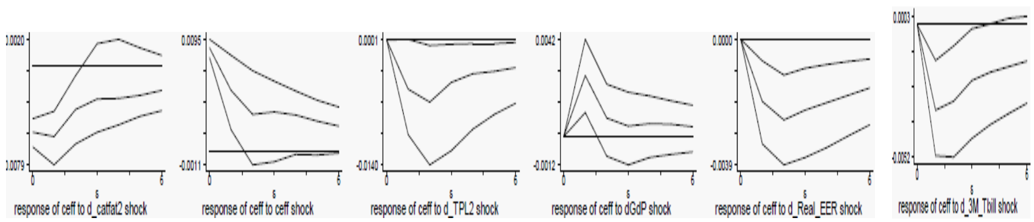
Figure 3.2: Liquidity Creation - Impulse Response Functions



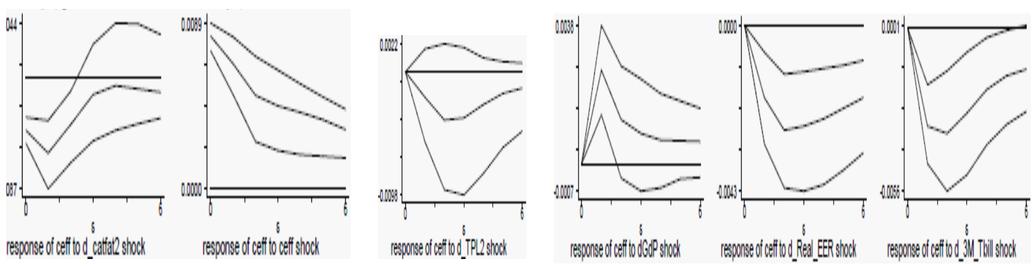
This figure illustrates the impulse response functions of Liquidity Creation with respect to a Bank, a Macroeconomic and a Financial shock, deriving from the panel vector autoregressive (PVAR) system for both the UK and Greek baseline scenario where there is no bank consolidation activity in the sector and the additional baseline scenario that indicates the current conditions of the Greek banking system after the recent wave of Greek banks' M&As. Specifically, 'd Catfat2', 'd TPL', 'd GDP', 'd Real EER' and 'd 3M Tbill' refer to the first differences of Liquidity Creation, Total Problem Loans (i.e. Bank shock), Gdp Growth Rate (i.e. Macroeconomic shock), Real Effective Exchange Rate (i.e. Financial shock) and Three month treasury bill rate (i.e. Financial shock) respectively, while 'Ceff' refers to the cost efficiency score (i.e. Bank shock).

Figure 3.3: Cost Efficiency - Impulse Response Functions

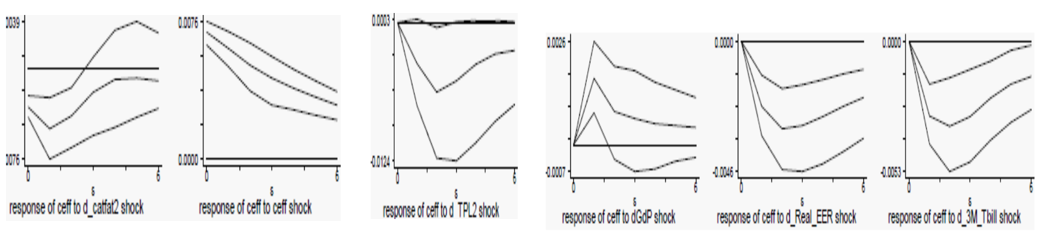
UK



Greece BEFORE the recent consolidation activity



Greece AFTER the recent consolidation activity



This figure illustrates the impulse response functions of Cost Efficiency with respect to a Bank, a Macroeconomic and a Financial shock, deriving from the panel vector autoregressive (PVAR) system for both the UK and Greek baseline scenario where there is no bank consolidation activity in the sector and the additional baseline scenario that indicates the current conditions of the Greek banking system after the recent wave of Greek banks' M&As. Specifically, 'd Catfat2', 'd TPL', 'd GDP', 'd Real EER' and 'd 3M Tbill refer to the first differences of Liquidity Creation, Total Problem Loans (i.e. Bank shock), Gdp Growth Rate (i.e. Macroeconomic shock), Real Effective Exchange Rate (i.e. Financial shock) and Three month treasury bill rate (i.e. Financial shock) respectively, while 'Ceff' refers to the cost efficiency score (i.e. Bank shock).

Table 3.1.a: UK - Historical M&As

	Acquirer	Target	Date of M&A
_1	Cheltenham & Gloucester BS	Essex Equitable BS	Feb. 1988
_2	Heart of England BS	Rowley Regis BS	Mar. 1988
_3	Heart of England BS	Kidderminster Equitable BS	Mar. 1988
_4	West of England BS	North Wilts Ridgeway BS	Mar. 1988
_5	Woolwich Equitable BS	Gateway BS	May. 1988
_6	Chelsea BS	City of London BS	Jul. 1988
_7	Cheshunt BS	Aid to Thrift BS	Jul. 1988
_8	Cheltenham & Gloucester BS	Bolton BS	Oct. 1988
_9	Cheltenham & Gloucester BS	Bury St Edmunds BS	Jan. 1989
_10	West of England BS	Regency	May. 1989
_11	Wessex BS	Portman BS	Jul. 1989
_12	Cheltenham & Gloucester BS	Bedford BS	Apr. 1990
_13	Cheltenham & Gloucester BS	Guardian BS	Apr. 1990
_14	Bradford & Bingley BS	Sheffield BS	Jun. 1990
_15	Cheltenham & Gloucester BS	Peckham BS	Jul. 1990
_16	Stroud & Swindon BS	Frome Selwood Permanent BS	Jul. 1990
_17	Cheltenham & Gloucester BS	Walthamstow BS	Oct. 1990
_18	Regency & West of England BS	Portman Wessex BS	Oct. 1990
_19	Sussex	Eastbourne Mutual BS	Oct. 1990
_20	Bradford & Bingley BS	Louth Mablethorpe & Sutton BS	Nov. 1990
_21	Bradford & Bingley BS	Hendon BS	Mar. 1991
_22	Bradford & Bingley BS	Hampshire BS	Jun. 1991
_23	Cheltenham & Gloucester BS	Portsmouth BS	Jun. 1991
_24	Bradford and Bingley	Leamington Spa	Jul. 1991
_25	Cheltenham & Gloucester BS	Bedford Crown BS	Jul. 1991
_26	Britannia BS	Mornington BS	Oct. 1991
_27	Bristol and West BS	Cheshunt BS	Dec. 1991
_28	Leeds Permanent BS	Southdown BS	Apr. 1992
_29	Woolwich BS	Town and Country BS	May.1992
_30	Northern Rock BS	Lancastrian BS	Jul. 1992
_31	Cheltenham & Gloucester BS	Mid-Sussex BS	Aug.1992
_32	Yorkshire	Haywards Health BS	Dec. 1992
_33	Northern Rock BS	Surrey BS	Jul. 1993
_34	Cheltenham & Gloucester BS	Heart of England BS	Oct. 1993
_35	Bradford & Bingley BS	Bexhill-on-Sea BS	Nov. 1993
_36	Portman BS	St Pancreas BS	Dec. 1993
_37	Northern Rock BS	North of England BS	Oct. 1994
_38	Universal BS	Tynemouth BS	Oct. 1994
_39	Halifax	Leeds Permanent BS	Aug. 1995
_40	Lloyds	Cheltenham and Gloucester	Aug. 1995
_41	Lloyds	TSB	Dec. 1995
_42	Stroud and Swindon BS	City and Metropolitan BS	Apr. 1996
_43	Abbey National	National and Provincial BS	Aug. 1996
_44	Bank of Ireland	Bristol and West	Jul. 1997
_45	Cumberland BS	West Cumbria BS	Jul. 1997
_46	Portman BS	Greenwich BS	Jul. 1997
_47	Abbey National	Cater Allen	Jul. 1997
_48	Halifax	Birmingham Midshires	Apr. 1999
_49	Mercantile BS	Standard BS	Sep. 1999
_50	Newcastle BS	Nottingham Imperial BS	Feb. 2000
_51	Royal Bank of Scotland	Natwest	Feb. 2000
_52	Yorkshire BS	Gainsborough BS	May. 2001
_53	Barclays	Woolwich	Nov. 2001
_54	Halifax	Bank of Scotland	Nov. 2001
_55	Derbyshire BS	Ilkeston Permanent BS	Aug. 2002

(Continued)

Table 3.1.a: UK - Historical M&As (Continued)

	Acquirer	Target	Date of M&A
_56	Derbyshire BS	Clay Cross BS	Dec. 2003
_57	Northern Rock	Legal and General Bank	Dec. 2003
_58	Portman BS	Staffordshire BS	Dec. 2003
_59	Britannia BS	Bristol and West	May. 2005
_60	Leeds and Holbeck BS	Mercantile BS	Aug. 2006
_61	Portman	Lambeth	Sep. 2006
_62	Newcastle	Universal	Dec. 2006
_63	Nationwide	Portman	Aug. 2007
_64	Abbey National	Alliance & Leicester	Sep. 2008
_65	Abbey National	Bradford & Bingley	Sep. 2008
_66	Lloyds	HBOS	Sep. 2008
_67	Yorkshire BS	Barnsley	Dec. 2008
_68	Nationwide	Cheshire	Dec. 2008
_69	Chelsea	Catholic	Dec. 2008
_70	Nationwide	Derbyshire	Dec. 2008
_71	Nationwide	Dunfermline	Mar. 2009
_72	Skipton Building Society	Scarborough BS	Mar. 2009
_73	Yorkshire BS	Chelsea BS	Apr. 2010
_74	Skipton BS	Chesham BS	Jun. 2010
_75	Coventry BS	Stroud & Swindon BS	Sep. 2010
_76	Yorkshire BS	Egg banking	JuL. 2011
_77	Yorkshire BS	Norwich & Peterborough BS	Nov. 2011
_78	Scottish BS	Century BS	Feb. 2013
_79	Nottingham BS	Shepshed BS	Jul. 2013

Notes: This tables reports all the merging and acquisition activity that has been undertaken domestically in the UK retail banking sector over the period 1988 to 2013.

Table 3.1.b: Greece - Historical M&As

	Acquirer	Target	Date of M&A
_1	EFG Eurobank	Interbank	Jul. 1996
_2	National Mortgage Bank of Greece	National Housing Bank of Greece	Apr. 1997
_3	Piraeus Bank	Chase Manhattan (1)	Aug. 1997
_4	Piraeus Bank	Credit Lyonnais Greece	Mar. 1998
_5	National Bank of Greece	National Mortgage Bank of Greece	Mar. 1998
_6	EFG Eurobank	Bank of Athens	Apr. 1998
_7	EFG Eurobank	Creta Bank	Jun. 1998
_8	Egnatia bank	Bank of Central Greece	May. 1999
_9	Alpha Bank	Ionian and Popular Bank of Greece	April. 1999
_10	Piraeus Bank	Macedonia Thrace Bank	Feb. 1999
_11	Piraeus Bank	Xios Bank	Apr. 1999
_12	Piraeus Bank	Nat.Westminster Bank (1)	May. 1999
_13	EFG Eurobank	Ergobank	Jun. 1999
_14	Telesis Investment Bank	Dwriki Bank	Jul. 2000
_15	EFG Eurobank-Ergasias	Telesis Investment Bank	Mar. 2001
_16	Piraeus Bank	Hellenic Industrial Development Bank	Jul. 2001
_17	National Bank of Greece	Nation. Invest. Bank for Industrial Development	Sep. 2002
_18	Aspis Bank	ABN-AMRO (1)	Jun. 2002
_19	Emporiki Bank of Greece	Bank of Investments	Apr. 2004
_20	Marfin Bank	Egnatia bank	Sep. 2005
_21	Marfin Bank	Laiki Bank	Oct. 2005
_22	Proton Bank	Omega Bank	Jun. 2006
_23	Aspis Bank	FBB First Business Bank (2)	Feb. 2007
_24	TT Hellenic Postbank	Aspis Bank	Jun. 2009
_25	Piraeus Bank	Agricultural (ATE)	Jul. 2012
_26	Alpha Bank	Emporiki Bank of Greece	Oct. 2012
_27	Piraeus Bank	General	Oct. 2012
_28	Piraeus Bank	Bank of Cyprus (3)	Mar. 2013
_29	Piraeus Bank	Marfin Egnatia (3)	Mar. 2013
_30	Piraeus Bank	Hellenic Bank (3)	Mar. 2013
_31	Piraeus Bank	Millennium	Apr. 2013
_32	National Bank of Greece	FBB First Business Bank	May. 2013
_33	National Bank of Greece	PRObank	Jul. 2013
_34	Eurobank-Ergasias	Proton Bank	Jul. 2013
_35	Eurobank-Ergasias	TT Hellenic Postbank	Jul. 2013

Notes: This tables reports all the merging and acquisition activity that has been undertaken domestically in the Greek banking sector over the period 1996 to 2013.

1. Piraeus Bank and Aspis Bank acquired the network of Chase Manhattan, Nat. Westiminster and ABN-AMRO respectively in Greece.

2. Aspis Bank in 2007 acquired 50% of the network of FBB First Business Bank.

3. Piraeus bank proceeded in the acquisition of the banking operations in Greece of: Bank of Cyprus, Cyprus Popular Bank (Marfin Egnatia) and Hellenic Bank.

Table 3.2: Bank activities of liquidity measures

Assets		
Illiquid assets (weight = 1/2) by Category	Semiliquid assets (weight = 0) by Category	Liquid assets (weight = –1/2)
Commercial real estate loans (CRE)	Residential real estate loans (RRE)	Cash and due from other institutions
Loans to finance agricultural production	Consumer loans	All securities
Other loans and leases financing	Loans to depository institutions	Trading assets
Other real estate owned (OREO)	Loans to state and local governments	Fed funds sold
Customers' liability on bankers acceptances	Loans to foreign governments	
Customers' liability on bankers acceptances		
Intangible assets		
Premises		
Other assets		
Illiquid assets (weight = 1/2) by Maturity	Semiliquid assets (weight = 0) by Maturity	
Loans and leases with a remaining maturity > 1 year	Loans and leases with a remaining maturity <= 1 year	
	Liabilities plus equity	
Liquid liabilities (weight = 1/2)	Semiliquid liabilities (weight = 0)	Illiquid liabilities plus equity (weight = –1/2)
Transactions deposits	Time deposits	Bank's liability on bankers acceptances
Savings deposits	Other borrowed money	Subordinated debt
Overnight federal funds purchased		Overnight federal funds purchased
Trading liabilities		Other liabilities
		Equity
	Off-balance sheet: Financial guarantees	
Illiquid guarantees (weight = 1/2)	Semiliquid guarantees (weight = 0)	Liquid guarantees (weight = –1/2)
Unused commitments	Net credit derivatives	Net participations acquired
Net standby letters of credit	Net securities lent	
Commercial and similar letters of credit		
All other off-balance sheet liabilities		
	Off-balance sheet: Derivatives	
		Liquid derivatives (weight=?1/2)
		Interest rate derivatives
		Foreign exchange derivatives
		Equity and commodity derivatives

Notes: This table reports definitions of both 'on' and 'off' balance sheet items in terms of their liquidity, which is the basis for calculation of the liquidity creation measures. The general functional form to calculate liquidity creation is

Liquidity Creation (LC) = [½ × illiquid assets (cat) + 0 × semi-liquid assets (cat) – ½ × liquid assets (cat)] +
[½ × liquid liabilities + 0 × semi-liquid liabilities – ½ × illiquid liabilities – ½ × equity capital] +
[½ × illiquid guarantees + 0 × semi-liquid guarantees – ½ × liquid guarantees – ½ × liquid derivatives]

In line with Berger and Bouwman (2009) methodology:
a. Step 1: We classify all bank activities as liquid, semiliquid, or illiquid. b. Step 2: We assign weights to the activities classified in step 1.
c. Step 3: We combine bank activities as classified in step 1 and as weighted in step 2 in different ways to construct four liquidity creation measures.
d. We classify loans both by category and maturity.

Table 3.3.a: UK - Financial Intermediaries Analysis of characteristic banking indicators

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
ABC Int.	1996-2011	16	3.19	1.38	2.33	0.41	5.72	0.35
AIB Bank	1992-2008	17	2.23	0.14	2.05	0.14	0	0.25
AIB Group	1995-2011	17	25.81	16.41	22.26	1.36	219.22	2.86
Abbey Nat.	1990-2011	22	190.34	27.9	126.34	3.65	45.36	21.09
Adam & Company	1989-2011	23	1.63	0.59	1.52	0.08	1.47	0.18
Ahli United	1989-2011	23	2.78	1.29	2.32	0.21	10.63	0.31
Alliance & Leic. BS	1988-1996	9	29.95	23.6	26.42	1.49	106.78	3.32
Alliance & Leic. Bank	1995-2006	12	5.44	1.65	4.32	0.45	6.17	0.6
Alliance & Leic. Plc	1996-2011	16	80.46	57.6	59.22	2.64	182.14	8.92
Alpha Bank	1989-2011	23	0.59	0.29	0.5	0.08	1.49	0.07
Anglo-Romanian	1989-2010	22	0.25	0.11	0.17	0.06	2.26	0.03
Arbuthnot	1991-2011	21	0.27	0.14	0.21	0.04	1.55	0.03
BMCE Int.	2006-2011	6	0.36	0.17	0.28	0.06	0.55	0.04
Bank Leumi	1996-2011	16	1.72	1.17	1.5	0.15	7.13	0.19
Bank Mandiri	1999-2011	13	0.17	0.08	0.11	0.05	3.42	0.02
Bank Saderat	1996-2011	16	0.82	0.18	0.55	0.19	0.61	0.09
Bank of Beirut	2002-2011	10	0.35	0.14	0.27	0.06	0.08	0.04
Bank of China	2007-2011	5	1.18	0.6	1.01	0.24	7.36	0.13
Bank of Cyprus	1997-2003	7	0.85	0.55	0.75	0.07	0.43	0.09
Bank of N.Y. Mellon	1997-2011	15	5.11	0.22	4.47	0.33	0	0.57
Bank of Scotland	1990-2011	22	368.13	256.88	260.55	12.28	3821.53	40.79
Bank of Tokyo	1988-1996	9	0.68	0.28	0.59	0.06	5.91	0.08
Bank of Philip. Isl.	2009-2011	3	35.73	0.49	3.45	32.01	18	3.96
Barclays Bank	1992-2011	20	1262.61	431.68	647.54	42.14	3266.07	139.91
Barclays Priv. & Tr.	2002-2005	4	2.07	0.18	1.79	0.24	0.47	0.23
Barclays Priv. Clien.	2002-2008	7	27.88	4.01	26.22	1.06	10.92	3.09
Barnsley BS	1992-2007	16	0.45	0.34	0.41	0.03	0.27	0.05
Bath BS Sav. & Inv.	1995-2010	16	0.26	0.19	0.24	0.02	0.09	0.03
Beneficial Bank	1988-1998	11	2.2	1.95	1.31	0.23	98.35	0.24
Beverley BS	1996-2011	16	0.17	0.13	0.16	0.01	0.18	0.02
Birmingham Mid. BS	1988-1998	11	8.43	6.96	7.63	0.4	16.74	0.93
Bradford & Bingley BS	1988-1999	12	23.59	18.76	21.38	1.26	24.3	2.61
Bradford & Bingley Int.	2007-2010	4	3.91	3.74	3.53	0.37	0	0.43
Bradford & Bingley Bank	1999-2011	13	68.99	54.42	35.75	2.18	181.36	7.65
Bristol & West BS	1988-1996	9	10.93	8.83	9.81	0.54	39.43	1.21
Britannia BS	1989-2009	21	35.06	22.06	27.75	1.64	19.22	3.89
British Arab	1989-2011	23	2.68	0.62	2.3	0.21	5.32	0.3
Buckinghamshire BS	2003-2011	9	0.25	0.18	0.23	0.02	0.02	0.03
Butterfield Guernsey	1996-2011	16	1.12	0.22	1.02	0.07	0.62	0.12
Butterfield Holdings	1992-2010	19	0.5	0.11	0.44	0.05	-0.01	0.06
Cambridge BS	1996-2011	16	1.24	0.91	1.15	0.08	0.49	0.14
Capital One	2002-2011	10	6.96	6.07	2.64	0.65	382.69	0.77
Catholic BS	1997-2007	11	0.06	0.04	0.06	0	0	0.01
Chelsea BS	1990-2009	20	12.72	9.61	11.08	0.55	12.7	1.41
Cheltenham & Gloucester BS	1988-1995	8	22.82	19.26	20.98	1.08	79.71	2.53
Cheltenham & Gloucester Bank	1996-2011	16	66.45	94.73	88.26	2.41	-6.19	7.36
Cheshire BS	1990-2007	18	5.2	4.02	4.07	0.25	4.04	0.58
Citibank	1989-2011	23	31.44	9.95	24.01	2.69	234.57	3.48
City of Derry BS	1998-2010	13	0.04	0.03	0.04	0	0.16	0
Co-operative	1990-2011	22	17.88	11.85	15.27	0.93	112.16	1.98
Consolidated Credits	2002-2011	10	0.15	0	0.12	0.03	0	0.02
Coventry BS	1989-2011	23	18.11	12.92	15.16	0.71	8.33	2.01
Credit Agricole	2000-2004	5	2.6	0.47	1.45	0.07	0	0.29
Credit Suisse	1997-2011	15	1.75	0.44	1.59	0.09	0	0.19
Cuscatlan Bank and Trust	2002-2006	5	0.33	0.19	0.28	0.04	0.38	0.04

(Continued)

Table 3.3.a: UK - Financial Intermediaries Analysis of characteristic banking indicators (Continued)

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
DB UK	1996-2011	16	14.44	3	7.57	1.31	1.39	1.6
Darlington BS	1996-2011	16	0.87	0.67	0.8	0.06	0.52	0.1
Derbyshire BS	1992-2007	16	6.4	5.02	5.85	0.34	0.92	0.71
Dexia Municipal	1992-1999	8	0.61	0.52	0.53	0.05	0.28	0.07
Dunbar	1995-2010	16	1.12	0.99	0.85	0.21	70.78	0.12
Duncan Lawrie	2008-2010	3	0.24	0.06	0.2	0.04	0	0.03
Dunfermline BS	1992-2007	16	3.26	2.52	2.99	0.17	0.84	0.36
Ecology BS	1997-2011	15	0.1	0.07	0.09	0.01	0.09	0.01
Egg	1996-2011	16	11.89	7.14	9.81	0.58	258.35	1.32
Europe Arab	2005-2011	7	5.61	2.51	5.38	0.42	47.33	0.62
FBN	2003-2011	9	1.49	0.34	1.25	0.11	-1.35	0.17
FIBI	1996-2011	16	0.35	0.25	0.27	0.07	0.63	0.04
Fairbairn	1998-2011	14	1.01	0.26	0.94	0.06	0.3	0.11
Finsbury Pavement	1991-2006	16	0.8	0.16	0.58	0.17	0.17	0.09
Furness BS	1996-2011	16	1.2	0.93	1.1	0.07	0.36	0.13
Gainsborough BS	1992-2000	9	0.05	0.03	0.04	0	0	0.01
Ghana	1998-2011	14	0.51	0.05	0.43	0.07	0.16	0.06
Gresham Trust	1993-2000	8	0.15	0	0.02	0.13	0	0.02
HBOS	2000-2011	12	494.11	387.03	383.7	26.91	7010.74	54.75
HFC	1989-2011	23	4.29	3.25	2.35	0.46	230.8	0.48
HSBC Middle East	1989-2011	23	12.93	7.17	10.38	1.04	144.53	1.43
HSBC	1989-2011	23	488.09	200.1	279.61	22.28	1175.48	54.09
Habib Allied	2001-2011	11	122.81	40.29	103.93	11.85	246.18	13.61
Habibsons	1996-2011	16	0.32	0.08	0.29	0.02	0.41	0.04
Halifax	1996-2006	11	301.63	220.16	264.75	10.49	526.95	33.43
Harpenden BS	1996-2011	16	0.21	0.16	0.19	0.01	0.09	0.02
Heritable	1989-2007	19	0.46	0.41	0.38	0.05	1.3	0.05
ICBC	2003-2011	9	0.91	0.35	0.72	0.16	-0.16	0.1
Ilkeston Permanent BS	1997-2000	4	0.03	0.02	0.02	0	0	0
Isle of Man Bank Limited	1995-2011	17	5.09	1.11	4.64	0.36	0.27	0.56
Italian Int.	1988-1997	10	2.37	0.35	2.14	0.12	1.16	0.26
JP Morgan	1996-2011	16	1.95	1.5	0.14	0.98	0	0.22
Jordan Int.	1996-2011	16	0.33	0.07	0.28	0.04	6.69	0.04
KDB Bank	1992-1998	7	0.38	0.08	0.31	0.05	5	0.04
Kaupthing Singer & Friedlander	1989-2007	19	1968.65	1233.45	1638.98	144.34	7931.22	218.15
Kingdom	2009-2011	3	0.08	0.05	0.07	0.01	0.4	0.01
Kookmin	1995-2010	16	0.26	0.03	0.21	0.04	1.46	0.03
Lazard & Co Holdings	1999-2011	13	1.1	0.31	0.81	0.21	0	0.12
Leeds BS	1989-2011	23	9.75	7.63	8.28	0.53	23.14	1.08
Leek United BS	1996-2011	16	1.1	0.86	1.01	0.07	0.15	0.12
Lloyds (BLSA)	1992-2001	10	1.96	0.72	1.7	0.12	13.81	0.22
Lloyds	1988-1998	11	132.06	78.23	109.79	5.85	999.95	14.63
Lloyds TSB	1998-2011	14	539.94	309.35	373.09	25.28	3962.68	59.83
Lloyds TSB Scotland	1989-2010	22	11.54	8.41	10.4	0.73	43.28	1.28
London Int.	2001-2006	6	0.01	0	0	0.01	0	0
London Trust	1991-1998	8	0.06	0.03	0.04	0.01	0.7	0.01
MBNA Europe Bank	1995-2010	16	11.94	9.83	6.49	1.82	607.25	1.32
Manchester BS	1990-2011	22	0.83	0.64	0.75	0.05	0.99	0.09
Mansfield Building Society	1995-2011	16	0.32	0.25	0.29	0.03	0.05	0.04
Market Harborough BS	1998-2011	14	0.64	0.5	0.59	0.04	0.03	0.07
Marsden BS	1996-2011	16	0.53	0.38	0.48	0.04	0.59	0.06
Melli	2001-2011	11	1.54	0.19	1.14	0.27	4.49	0.17
Melton Mowbray BS	1996-2011	16	0.6	0.43	0.54	0.05	0.2	0.07
Mercantile BS	1992-2005	14	0.29	0.22	0.26	0.02	0.04	0.03
Merrill Lynch	1990-2005	16	11.59	5.81	8.24	0.8	3.28	1.28

(Continued)

Table 3.3.a: UK - Financial Intermediaries Analysis of characteristic banking indicators (Continued)

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
Morgan Stanley	2001-2011	11	7.61	2.14	4.1	1.02	17.26	0.84
National Bank of Kuwait	1996-2011	16	1.88	0.65	1.55	0.28	0.66	0.21
National Counties BS	1996-2011	16	1.57	1.15	1.11	0.44	1.28	0.17
National Westminster	1989-2011	23	294.59	167.49	240.32	14.12	2146.48	32.65
Nationwide BS	1990-2011	22	175.11	135.5	145.05	6.57	241.61	19.41
Newcastle BS	1989-2011	23	5.16	4.02	4.48	0.27	3.85	0.57
Northern	1995-2010	16	7.54	5.71	6.24	0.48	42.29	0.84
Northern Rock	1996-2011	16	89.7	72.91	51.35	2.29	370.68	9.94
Northern Rock BS	1987-1996	10	10.41	8.61	9.56	0.48	14.03	1.15
Norwich & Peterborough BS	1995-2010	16	5.52	4.17	5.07	0.27	4.93	0.61
Nottingham BS	1992-2011	20	3.07	2.48	2.82	0.18	0.92	0.34
PNB	1997-2011	15	0.03	0	0.02	0.01	0.11	0
Penrith BuS	2008-2011	4	0.14	0.09	0.12	0.02	0	0.02
Portman BS	1989-2006	18	15.72	11.46	13.84	0.77	7.4	1.74
Principality BS	1989-2011	23	6.22	4.72	5.48	0.34	9.59	0.69
Progressive BS	1996-2011	16	1.84	1.46	1.71	0.09	1.46	0.2
Prudential-Bache	1996-2001	6	0.58	0.21	0.48	0.08	0	0.06
Riggs	1989-2004	16	0.41	0.24	0.34	0.05	4.45	0.05
Riyad	1993-1997	5	0.16	0.02	0.12	0.05	0.1	0.02
Royal Bank of Scotland Int.	1996-2008	13	29.11	5.41	26.63	2.08	35.04	3.23
Royal Bank of Scotland	1995-2011	17	930.46	401.98	482.44	42.5	4124.73	103.11
Saffron BS	1996-2011	16	1.09	0.77	1.01	0.06	0.36	0.12
Sainsbury's	2002-2011	10	6.86	3.65	6.2	0.31	104.87	0.76
Santander	1989-2011	23	243.49	150.01	177.69	8.59	461.62	26.98
Schroders	1989-2011	23	8.2	1.03	3.9	1.6	5.18	0.91
Secure Trust	1999-2011	13	0.13	0.08	0.11	0.01	1.11	0.01
Shepshed BS	1997-2011	15	0.12	0.08	0.11	0.01	0.08	0.01
Skipton BS	1989-2011	23	13.26	9.2	11.44	0.71	16.35	1.47
Staffordshire BS	1989-2002	14	1.82	1.5	1.64	0.13	1.7	0.2
Standard	2000-2011	12	21.72	5.95	12.61	1.01	31.88	2.41
Standard Chartered	1998-2011	14	240.37	102.85	145.94	16.09	677.87	26.64
Standard Chartered Plc	1990-2011	22	122.96	72.43	124.62	11.31	601.8	13.63
Stroud & Swindon BS	1994-2009	16	3.64	2.61	3.38	0.14	0.45	0.4
Swansea BS	1996-2011	16	0.16	0.11	0.14	0.01	0.07	0.02
TSB	1988-1997	10	41.56	27.36	35.78	2.69	276.84	4.61
Teachers' BS	1996-2011	16	0.36	0.28	0.25	0.11	-0.01	0.04
The Access	2008-2011	4	0.3	0.03	0.26	0.04	0	0.03
Tipton & Coseley BS	2001-2011	11	0.5	0.39	0.46	0.03	0.41	0.06
Turkish	1996-2011	16	0.18	0.06	0.16	0.03	0.04	0.02
Ulster	1989-2011	23	29.02	21.05	21.82	2.3	812.56	3.22
Union	2005-2011	7	0.94	0.04	0.87	0.05	-0.08	0.1
United National	2001-2011	11	0.23	0.09	0.16	0.06	0.15	0.03
United Trust	1999-2011	13	0.13	0.09	0.1	0.02	1.44	0.01
Unity Trust	1991-2011	21	0.54	0.12	0.49	0.04	1.08	0.06
Universal BS	1992-2005	14	0.6	0.48	0.54	0.03	0.31	0.07
VTB Capital	2004-2011	8	4.91	1.53	1.67	0.65	15.32	0.54
Vernon BS	1993-2011	13	51.9	39.3	48.13	3.51	9.98	5.75
Weatherbys	1997-2011	15	0.23	0.07	0.2	0.02	0.83	0.03
Wesleyan	2001-2011	11	0.16	0.05	0.15	0.02	0.98	0.02
West Merchant	1988-1997	10	4.39	0.78	3.79	0.13	7.81	0.49
Woolwich BS	1988-1996	9	34.41	28.12	31.44	1.81	83.53	3.81
Yorkshire BS	1989-2011	23	25.51	16.76	21.5	1.17	12.8	2.83
Total		2327	9024.17	4977.99	6409.96	500.22	42418.32	100

Notes: This table presents an overview of all the UK financial intermediaries throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, Mar. Pr represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Power (measured as each bank's share of the indrustry's total assets) respectively. 'B' stands for billions while 'M' for millions.

Table 3.3.b: Greece- Financial Intermediaries Analysis of characteristic banking indicators

name	Years	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	Mar. Pr (%)
Aegean Baltic	2003-2011	9	0.3	0.17	0.23	0.07	1.59	0.1
Agricultural (ATE)	1993-2011	19	22.86	16.02	20.41	1.16	154.05	7.8
Alpha	1993-2011	19	37.62	24.22	28.64	2.42	422.81	12.9
Attica	1993-2011	19	2.9	2.16	2.54	0.25	33.54	1
Bank of Athens	1993-1997	5	0.36	0.18	0.32	0.03	2.15	0.1
Bank of Central Greece	1993-1998	6	0.51	0.24	0.44	0.05	2.84	0.2
Bank of Crete (Cretabank)	1993-1998	6	1.24	0.62	1.13	0.07	6.38	0.4
Emporiki (Commercial)	1993-2011	19	21.58	14.61	17.91	1.19	313.21	7.4
Ergobank	1993-1999	7	4.21	1.6	3.53	0.34	18.21	1.4
Eurobank Ergasias	1993-2011	19	42.12	26.19	33.16	2.66	753.08	14.4
FBB First Business	2002-2011	10	1.76	1.39	1.59	0.15	27.33	0.6
General	1993-2011	19	3.5	2.71	3.13	0.19	103.4	1.2
Ionian and Popular	1993-1998	6	5.53	1.75	4.79	0.26	39.29	1.9
Laiki	1993-2005	13	1.62	1.04	1.47	0.12	16.96	0.6
Macedonia Thrace	1993-1999	7	1.53	0.62	1.32	0.14	12.58	0.5
Marfin	1993-2005	13	0.48	0.2	0.43	0.04	4.28	0.2
Marfin Egnatia	1993-2010	18	8.58	5.59	7.34	0.5	70.25	2.9
Millennium	2000-2011	12	5.7	4.24	4.7	0.33	31.51	1.9
National Bank of Greece (Ethiki)	1993-2011	19	68.15	35.19	58.65	4.02	465.16	23.3
National Mortgage Bank	1993-1997	5	7.09	3.53	5.63	0.22	8.3	2.4
Omega	2001-2004	4	0.76	0.45	0.67	0.08	2.7	0.3
PRObank	2001-2011	11	3.42	2.42	3.03	0.3	35.49	1.2
Pancretan Cooperative	2002-2011	10	1.74	1.42	1.49	0.19	0	0.6
Panellinia	2005-2011	7	1.04	0.78	0.91	0.11	12.34	0.4
Piraeus	1993-2011	19	25.57	17.15	20.84	1.42	332.39	8.8
Proton	2002-2010	9	1.92	0.98	1.59	0.28	19.76	0.7
T Bank	1993-2010	18	2.26	1.58	1.89	0.14	11.55	0.8
TELESIS Investment	1993-2000	8	0.35	0.14	0.25	0.08	1.53	0.1
TT Hellenic Postbank	1998-2011	14	16.51	5.78	14.72	1.32	37.74	5.7
Xiosbank	1993-1998	6	0.93	0.35	0.84	0.05	3.18	0.3
Total		356	292.12	173.29	243.58	18.16	2943.63	100

Notes: This table presents an overview of all the Greek financial intermediaries throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, Mar. Pr represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Power (measured as each bank's share of the indrustry's total assets) respectively. 'B' stands for billions while 'M' for millions.

Table 3.4.a: UK - Time Series Analysis of characteristic banking indicators

year	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	HHI
1988	13	10.73	18.09	9.58	0.55	25.77	0.19
1989	40	16.6	26.98	14.33	0.86	338.95	0.12
1990	49	19.4	36.34	16.76	0.96	205.41	0.08
1991	53	21.63	37.9	18.64	1.11	287.72	0.08
1992	66	17.16	25.94	14.39	0.87	227.15	0.08
1993	69	15.95	23.62	13.04	0.81	147.54	0.07
1994	70	19.92	31.13	15.9	1.01	76.32	0.08
1995	80	14.56	22.57	11.56	0.89	45.88	0.06
1996	110	14.76	25.06	11.75	0.92	30.11	0.05
1997	114	18.04	29.84	14.22	0.99	38.9	0.08
1998	115	20.52	34.13	16.16	1.16	100.34	0.06
1999	116	18.3	29.59	14.47	1.2	73.44	0.05
2000	117	24.06	35.9	18.94	1.7	67.05	0.07
2001	120	23.65	34.3	18.73	1.77	95.16	0.06
2002	125	33.11	53.37	26.58	2.05	127.42	0.07
2003	127	35.3	63.01	27.02	2.76	137.02	0.06
2004	127	73.56	142.07	59.93	5.16	351.77	0.15
2005	126	87.6	150.83	62.92	4.42	223.69	0.12
2006	121	104.11	204.36	68.12	6.32	541.66	0.14
2007	120	132.24	264.95	98.8	8.22	579.07	0.23
2008	116	107.92	157.32	53.52	4.1	783.78	0.09
2009	116	87.82	142.22	53.25	7.16	971.87	0.08
2010	113	86.56	135.5	51.52	7.32	675.16	0.07
2011	101	138.39	213.96	80.69	10.43	863.94	0.08
Total	2324	1141.89	1938.98	790.82	72.74	7015.12	0.09

Notes: This table presents an overview of the UK banking system throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, HHI represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Concentration (expressed by the Herfindahl-Hirschman (HHI) Index and it is defined as the sum of the squares of the market shares of all banks in the sample for each year: a HHI index below 0.01 indicates a highly competitive index, a HHI index below 0.15 indicates an unconcentrated index, a HHI index between 0.15 to 0.25 indicates moderate concentration, while a HHI index above 0.25 indicates high concentration.) respectively. 'B' stands for billions while 'M' for millions.

Table 3.4.b: Greece - Time Series Analysis of characteristic banking indicators

year	Num OBS	T.A (B)	Gr. Ls (B)	Dep. (B)	Eqt. (B)	L.L.P (M)	HHI
1993	19	3.84	5.24	3.28	0.17	12.91	0.21
1994	19	4.85	6.89	4.18	0.22	18.54	0.23
1995	19	6.05	8.7	5.25	0.26	13.78	0.21
1996	21	5.04	6.95	4.49	0.24	24.62	0.16
1997	21	5.74	6.92	5.07	0.27	32.97	0.2
1998	20	6.79	8.19	6.06	0.42	41.5	0.16
1999	16	8.77	9.1	7.47	0.9	45.36	0.16
2000	15	9.31	8.77	8.04	0.83	38.31	0.16
2001	15	9.94	8.76	8.77	0.76	44.99	0.17
2002	18	9.85	10.33	8.76	0.6	47.85	0.18
2003	20	11.84	14.96	10.17	0.81	75.79	0.16
2004	21	13.33	18.15	10.83	0.79	89.34	0.15
2005	21	13.44	15.86	10.93	0.93	75.35	0.14
2006	19	19.2	25.29	15.08	1.39	125.15	0.14
2007	19	26.95	39.68	19.55	2.27	120.8	0.13
2008	19	31.71	44.12	25.05	2.13	260.27	0.14
2009	19	34.67	49.95	28.1	2.85	424.91	0.14
2010	20	30.36	40.57	24.77	2.74	562.62	0.13
2011	15	30.54	39.51	26.21	1.1	1779.96	0.19
Total	356	282.22	367.94	232.06	19.68	3835.02	0.17

Notes: This table presents an overview of the Greek banking system throughout our sample period. T.A, Gr. Ls, Dep., Eqt, L.L.P, HHI represent average values of Total Assets, Gross loans, Deposits, Equity, Loans and loss Provisions and Market Concentration (expressed by the Herfindahl-Hirschman (HHI) Index and it is defined as the sum of the squares of the market shares of all banks in the sample for each year: a HHI index below 0.01 indicates a highly competitive index, a HHI index below 0.15 indicates an unconcentrated index, a HHI index between 0.15 to 0.25 indicates moderate concentration, while a HHI index above 0.25 indicates high concentration.) respectively. 'B' stands for billions while 'M' for millions.

Table 3.5.a: UK - Liquidity Creation of Historical M&As

	Acquirer in 't-1' (M)	*Target in 't-1' (M)*	*Consolidated Instutition in 't+1' (M)*
_1	Cheltenham & Gloucester BS	Essex Equitable BS	Cheltenham & Gloucester BS
	4249.1	386.28	5411.8
_2	Heart of England BS	Rowley Regis BS	Heart of England BS
	265.57	53.11	416.29
_3	Heart of England BS	Kidderminster Equitable BS	Heart of England BS
	265.57	66.39	416.29
_4	West of England BS	North Wilts Ridgeway BS	West of England BS
	294.22	163.46	367.89
_5	Woolwich Equitable BS	Gateway BS	Woolwich Equitable BS (3)
	10182.2	3394.07	13750
_6	Chelsea BS	City of London BS	Chelsea BS
	1526.9	79.53	1606.5
_7	Cheshunt BS	Aid to Thrift BS	Cheshunt BS
	349.34	148.12	658.74
_8	Cheltenham & Gloucester BS	Bolton BS	Cheltenham & Gloucester BS
	4249.1	249.95	5411.8
_9	Cheltenham & Gloucester BS	Bury St Edmunds BS	Cheltenham & Gloucester BS
	5411.8	386.56	8656.8
_10	West of England BS	Regency	Regency & West of England BS
	367.89	487.55	957.42
_11	Wessex BS	Portman BS	Portman Wessex BS
	395.07	908.65	1723.35
_12	Cheltenham & Gloucester BS	Bedford BS	Cheltenham & Gloucester BS
	8656.8	577.12	11158.35
_13	Cheltenham & Gloucester BS	Guardian BS	Cheltenham & Gloucester BS
	8656.8	618.34	11158.35
_14	Bradford & Bingley BS	Sheffield BS	Bradford & Bingley BS
	6725.2	499.64	8993.55
_15	Cheltenham & Gloucester BS	Peckham BS	Cheltenham & Gloucester BS
	8656.8	541.05	11158.35
_16	Stroud & Swindon BS	Frome Selwood Permanent BS	Stroud & Swindon BS
	474.75	32.52	522.3
_17	Cheltenham & Gloucester BS	Walthamstow BS	Cheltenham & Gloucester BS
	8656.8	509.22	11158.35
_18	Regency & West of England BS	Portman Wessex BS	Portman BS
	957.42	1723.35	1946.95
_19	Sussex	Eastbourne Mutual BS	Southdown BS
	486.45	413.12	1000.64
_20	Bradford & Bingley BS	Louth Mablethorpe & Sutton BS	Bradford & Bingley BS
	6725.2	439.56	8993.55
_21	Bradford & Bingley BS	Hendon BS	Bradford & Bingley BS
	8993.55	576.51	9912.75
_22	Bradford & Bingley BS	Hampshire BS	Bradford & Bingley BS
	8993.55	548.39	9912.75
_23	Cheltenham & Gloucester BS	Portsmouth BS	Cheltenham & Gloucester BS
	11158.35	557.92	12717.5
_24	Bradford and Bingley	Leamington Spa	Bradford and Bingley
	8993.55	505.26	9912.75
_25	Cheltenham & Gloucester BS	Bedford Crown BS	Cheltenham & Gloucester BS
	11158.35	743.89	12717.5
_26	Britannia BS	Mornington BS	Britannia BS
	6120.2	425.01	6592.3
_27	Bristol and West BS	Cheshunt BS	Bristol and West BS
	5171.05	397.77	5700.3

(Continued)

Table 3.5.a: UK - Liquidity Creation of Historical M&As (Continued)

	Acquirer in 't-1' (M)	*Target in 't-1' (M)*	*Consolidated Instutition in 't+1' (M)*
_28	Leeds Permanent BS	Southdown BS	Leeds Permanent BS
	913.44	375.9	1564.29
_29	Woolwich BS	Town and Country BS	Woolwich BS
	17980.25	628.68	18700.75
_30	Northern Rock BS	Lancastrian BS	Northern Rock BS
	4654.7	427.04	5577.45
_31	Cheltenham & Gloucester BS	Mid-Sussex BS	Cheltenham & Gloucester BS
	12717.5	508.7	13273.4
_32	Yorkshire	Haywards Health BS	Yorkshire
	3768.6	348.94	4138.2
_33	Northern Rock BS	Surrey BS	Northern Rock BS
	5577.45	625.73	7577.6
_34	Cheltenham & Gloucester BS	Heart of England BS	Cheltenham & Gloucester BS
	13273.4	829.59	14480.85
_35	Bradford & Bingley BS	Bexhill-on-Sea BS	Bradford & Bingley BS
	10135.35	542	11215
_36	Portman BS	St Pancreas BS	Portman BS
	2121.3	235.7	2454.4
_37	Northern Rock BS	North of England BS	Northern Rock BS
	7577.6	911.76	8701.1
_38	Universal BS	Tynemouth BS	Universal BS
	774.69	227.85	1152.36
_39	Halifax BS	Leeds Permanent BS	Halifax BS
	52611.55	2086.42	71594.6
_40	Lloyds	Cheltenham and Gloucester	Lloyds
	61974.5	24417.1	105024.65
_41	Lloyds	TSB	Lloyds TSB
	61974.5	13810	105024.65
_42	Stroud and Swindon BS	City and Metropolitan BS	Stroud and Swindon BS
	708.6	48.2	836.4
_43	Abbey Nat.	National and Provincial BS	Abbey Nat.
	37461.5	2148.76	49600
_44	Bank of Ireland	Bristol and West BS	Bristol and West BS (4)
	561.3	6987.85	10052.3
_45	Cumberland BS	West Cumbria BS	Cumberland BS
	504.15	38.78	583.15
_46	Portman BS	Greenwich BS	Portman BS
	2885.75	129.15	3289.15
_47	Abbey Nat.	Cater Allen	Abbey Nat.
	96485	-14.25	108402
_48	Halifax	Birmingham Midshires	Halifax
	61491.5	6259.3	80996.5
_49	Mercantile BS	Standard BS	Mercantile BS
	116.9	7.95	138.85
_50	Newcastle BS	Nottingham Imperial BS	Newcastle BS
	1760.35	1161.85	3236.15
_51	Royal Bank of Scotland	Natwest	Royal Bank of Scotland
	68556	88615.5	217631.5
_52	Yorkshire BS	Gainsborough BS	Yorkshire BS
	8364.2	22.3	8761.65
_53	Barclays	Woolwich	Woolwich (5)
	186665.5	30529.2	227553.2
_54	Halifax	Bank of Scotland	HBOS
	114381	60172.5	187484

(Continued)

Table 3.5.a: UK - Liquidity Creation of Historical M&As (Continued)

	Acquirer in 't-1' (M)	*Target in 't-1' (M)*	*Consolidated Instutition in 't+1' (M)*
_55	Derbyshire BS	Ilkeston Permanent BS	Derbyshire BS
	2338.5	11.2	2459.7
_56	Derbyshire BS	Clay Cross BS	Derbyshire BS
	2459.7	14.14	2648.35
_57	Northern Rock	Legal and General Bank	Northern Rock
	2899.65	972.8	3130.5
_58	Portman BS	Staffordshire BS	Portman BS
	7529	1220.85	9854.6
_59	Britannia BS	Bristol and West	Britannia BS
	8119.25	16308.25	28684.25
_60	Leeds BS	Mercantile BS	Leeds BS
	4874.95	159.85	5908.85
_61	Portman BS	Lambeth BS	Portman BS
	7063	730.9	13663.4
_62	Newcastle BS	Universal BS	Newcastle BS
	2378.55	426.35	2953.4
_63	Nationwide BS	Portman BS	Nationwide BS
	89696.1	13663.4	111716.55
_64	Abbey Nat.	Alliance & Leicester	Santander
	93406.5	27361	195841
_65	Abbey Nat.	Bradford & Bingley	Santander
	93406.5	21544.15	195841
_66	Lloyds TSB	HBOS	Lloyds TSB
	136577.5	147494.5	334286.5
_67	Yorkshire BS	Barnsley BS	Yorkshire BS
	3771.3	251.15	1295
_68	Nationwide BS	Cheshire BS	Nationwide BS
	111716.55	3032.35	93965.5
_69	Chelsea BS	Catholic BS	Chelsea BS
	7885.1	29.5	8317.85
_70	Nationwide BS	Derbyshire BS	Nationwide BS
	111716.55	4918.1	93965.5
_71	Nationwide BS	Dunfermline BS	Nationwide BS
	93965.5	2395.75	116404.5
_72	Skipton BS	Scarborough BS	Skipton BS
	7777.65	2047.85	5775.65
_73	Yorkshire BS	Chelsea BS	Yorkshire BS
	9767.65	8574.7	13450.55
_74	Skipton BS	Chesham BS	Skipton BS
	7688.6	183.2	8266.55
_75	Coventry BS	Stroud & Swindon BS	Coventry BS
	12062	1494.3	14089.64

Notes: This table presents the level of liquidity creation of those UK financial institutions that involved in a domestic retail bank M&A activity during the period 1988-2011. The level of liquidity creation is calculated as described in Table 3.2.

1. We refer to the year of consolidation as 't', consequently we measure the liquidity creation of both the acquirer and target (i.e., Proforma bank) in time 't-1' and in time 't+1' regarding the consolidated institution.

2. 'M' stands for millions.

3. We do not include the last four consolidation activities that took place at 2011 and onwards due to unavailability of data.

4. In 1990, Woolwich Equitable BS renamed to Woolwich BS.

5. Bristol & West demutualised and was sold to Bank of Ireland becoming a division of the bank but maintaining its operations and branch network under the Bristol & West brand.

6. The Woolwich brand-name was retained after the acquisition

Table 3.5.b: Greece - Liquidity Creation of Historical M&As

	Acquirer in 't-1' (M)	*Target in 't-1' (M)*	*Consolidated Instutition in 't+1' (M)*
_1	EFG Eurobank	Interbank	EFG Eurobank
	304.95	335.445	729.4
_2	National Mortgage Bank of Greece	National Housing Bank of Greece	National Mortgage Bank of Greece
	1296.55	75.38081395	1498.6
_3	Piraeus Bank	Chase Manhattan (1)	Piraeus Bank
	460.2	115.05	2265.55
_4	Piraeus Bank	Credit Lyonnais Greece	Piraeus Bank
	2265.55	63.442	3386.75
_5	National Bank of Greece	National Mortgage Bank of Greece	National Bank of Greece
	6327.3	1498.6	10662.25
_6	EFG Eurobank	Bank of Athens	EFG Eurobank
	951.35	151	4365.65
_7	EFG Eurobank	Creta Bank	EFG Eurobank
	951.35	635.75	4365.65
_8	Egnatia bank	Bank of Central Greece	Egnatia bank
	827.2	240.6	1232.9
_9	Alpha Bank	Ionian and Popular Bank of Greece	Alpha Bank
	7136	1101	14842.95
_10	Piraeus Bank	Macedonia Thrace Bank	Piraeus Bank
	3386.75	747.1	5548.3
_11	Piraeus Bank	Xios Bank	Piraeus Bank
	3386.75	482.85	5548.3
_12	Piraeus Bank	Nat.Westminster Bank	Piraeus Bank
	3386.75	103.51	5548.3
_13	EFG Eurobank	Ergobank	EFG Eurobank-Ergasias
	4365.65	1762.35	6792.6
_14	Telesis Investment Bank	Dwriki Bank	Telesis Investment Bank
	56.1	46.75	160.55
_15	EFG Eurobank-Ergasias	Telesis Investment Bank	EFG Eurobank-Ergasias
	6792.6	160.55	9293.9
_16	Piraeus Bank	Hellenic Industrial Development Bank	Piraeus Bank
	7963.65	315.45	10315
_17	National Bank of Greece	Nation. Invest. Bank for Industrial Development	National Bank of Greece
	24244.25	290.4	30616.8
_18	Aspis Bank	ABN-AMRO	Aspis Bank
	996.85	46.27	1112.95
_19	Emporiki Bank of Greece SA	Bank of Investments	Emporiki Bank of Greece SA
	12599.1	242.67	18661.25
_20	Marfin Bank	Egnatia bank	Marfin Egnatia
	362.3	1724.9	4918.45
_21	Marfin Bank	Laiki Bank	Marfin Egnatia
	362.3	2044.55	4918.45
_22	Proton Bank	Omega Bank	Proton Bank
	772.6	693	1772.3
_23	Aspis Bank	FBB First Business Bank	Aspis Bank
	1760.8	1032.35	3096.35
_24	TT Hellenic Postbank	Aspis Bank	T Bank (Aspis)
	7026.75	1729.4	9114.5

Notes: This table presents the level of liquidity creation of those Greek financial institutions that involved in a domestic retail bank M&A activity during the period 1988-2011. The level of liquidity creation is calculated as described in Table 3.2.

1. We refer to the year of consolidation as 't', consequently we measure the liquidity creation of both the acquirer and target (i.e., Proforma bank) in time 't-1' and in time 't+1' regarding the consolidated institution.

2. 'M' stands for millions.

3. We do not include the last eleven consolidation activities that took place at 2011 and onwards due to unavailability of data.

Table 3.6.a: UK - Differences among Liquidity measures

	dif_catfat	dif_liquid1_acquirer	dif_liquid2_aquirer	dif_liquid1_target	dif_liquid2_target
dif_catfat	0	15 out 75 (20%)	9 out of 75 (12%)	16 out of 75 (21.33%)	12 out of 75 (16%)
dif_liquid1_acquirer	15 out 75 (20%)	0	7 out of 75 (9.33%)	13 out of 75 (17.33%)	12 out of 75 (16%)
dif_liquid2_acquirer	9 out of 75 (12%)	7 out of 75 (9.33%)	0	14 out of 75 (18.66%)	11 out of75 (14.6%)
dif_liquid1_target	16 out of 75 (21.33%)	13 out of 75 (17.33%)	14 out of 75 (18.66%)	0	4 out of 75 (5.3%)
dif_liquid2_target	12 out of 75 (16%)	12 out of 75 (16%)	11 out of75 (14.6%)	4 out of 75 (5.3%)	0

Notes: This table reports in how many of the historical M&A cases that took place in the UK banking sector we found differences in the liquidity creation level produced among each one of the three different liquidity measures, between time 't+1' and time 't-1'. Specifically, 'catfat' refers to the level of liquidity creation 'based on Berger and Bouwman (2009) measure as described in Table 3.2. 'Liquid1' and 'Liquid2' refer to the level of liquidity 'creation based on the following two equations:

a. Liquid1=Liquid Assets/Total Assets and b. Liquid2=Liquid Assets/Customer&Short Term Funding

dif_catfat' represents the difference in the level of liquidity creation between the consolidated institution in time 't+1' and the acquirer and target together (i.e., Proforma bank) in time 't-1'. On the contrary, 'dif_liquid1_acquirer' and 'dif_liquid1_target' represent the difference in the level of liquidity creation between the consolidated institution in time 't+1' and the acquirer (without the target institution) in time 't-1' or the target (without the acquirer institution) in time 't-1' as far as the 'absolute' measure of liquidity (i.e. 'Liquid1') is concerned. The same holds for the 'relative' measure of liquidity (i.e. 'Liquid2') .

Table 3.6.b: Greece - Differences among Liquidity measures

	dif_catfat	dif_liquid1_aquirer	dif_liquid2_aquirer	dif_liquid1_target	dif_liquid2_target
dif_catfat	0	3 out of 24 (12.5%)	3 out of 24 (12.5%)	5 out of 24 (20.83%)	5 out of 24 (20.83%)
dif_liquid1_aquirer	3 out of 24 (12.5%)	0	0 out of 24	4 out of 24 (16.66%)	4 out of 24 (16.66%)
dif_liquid2_aquirer	3 out of 24 (12.5%)	0 out of 24	0	4 out of 24 (16.66%)	4 out of 24 (16.66%)
dif_liquid1_target	5 out of 24 (20.83%)	4 out of 24 (16.66%)	4 out of 24 (16.66%)	0	0 out of 24
dif_liquid2_target	5 out of 24 (20.83%)	4 out of 24 (16.66%)	4 out of 24 (16.66%)	0 out of 24	0

Notes: This table reports in how many of the historical M&A cases that took place in the Greek banking sector we found differences in the liquidity creation level produced among each one of the three different liquidity measures, between time 't+1' and time 't-1'. Specifically, 'catfat' refers to the level of liquidity creation 'based on Berger and Bouwman (2009) measure as described in Table 3.2. 'Liquid1' and 'Liquid2' refer to the level of liquidity 'creation based on the following two equations:

a. Liquid1=Liquid Assets/Total Assets and b. Liquid2=Liquid Assets/Customer&Short Term Funding

dif_catfat' represents the difference in the level of liquidity creation between the consolidated institution in time 't+1' and the acquirer and target together (i.e., Proforma bank) in time 't-1'. On the contrary, 'dif_liquid1_acquirer' and 'dif_liquid1_target' represent the difference in the level of liquidity creation between the consolidated institution in time 't+1' and the acquirer (without the target institution) in time 't-1' or the target (without the acquirer institution) in time 't-1' as far as the 'absolute' measure of liquidity (i.e. 'Liquid1') is concerned. The same holds for the 'relative' measure of liquidity (i.e. 'Liquid2') .

Table 3.7.a: UK - Differences among Liquidity measures for each M&A activity

M&A activity	dif_catfat (M)	dif_liquid1_aquirer	dif_liquid2_aquirer	dif_liquid1_target	dif_liquid2_target
_1	776.42	0.01	1.41	0.09	10.85
_2	97.61	0.09	0.26	0.09	0.78
_3	84.33	0.04	0.26	0.09	0.74
_4	-89.79	0.04	0.76	0.13	0.98
_5	173.73	0.04	4.48	-0.68	14.99
_6	0.07	0.01	0.66	0.02	11.98
_7	161.28	0.04	1.62	0.09	2.09
_8	912.75	0.01	1.41	0.1	11.18
_9	2858.44	0.02	1.2	0.11	12.15
_10	101.98	0.55	4.37	0.47	3.02
_11	419.63	-0.09	16.67	0.03	3.27
_12	1924.43	-0.01	0.85	0.08	13.08
_13	1883.21	-0.01	0.85	0.09	13.01
_14	1768.71	0.01	0.84	0.13	14.28
_15	1960.5	-0.01	0.85	0.09	13.03
_16	15.03	0.02	2.31	0.08	9.15
_17	1992.33	-0.01	0.85	0.09	13.08
_18	-733.82	-0.53	11.58	-0.01	-0.85
_19	101.07	0.25	2.2	0.31	2.51
_20	1828.79	0.01	0.84	0.13	14.45
_21	342.69	-0.02	-1.78	0.1	12.55
_22	370.81	-0.02	-1.78	0.11	12.61
_23	1001.23	0.04	1.64	0.13	14.79
_24	413.94	-0.02	-1.78	0.11	12.69
_25	815.26	0.04	1.64	0.12	14.56
_26	47.09	0.04	4.04	0.11	12.52
_27	131.48	0.05	5.08	-0.19	7.77
_28	274.95	0.44	3.81	0.78	7.42
_29	91.82	0.02	2.1	0.07	12.48
_30	495.71	0.09	1.61	0.08	7.49
_31	47.2	0.03	1.3	0.16	16.16
_32	20.66	0.15	0.73	0.42	9.7
_33	1374.42	0.83	0.89	0.94	9.7
_34	377.86	0.32	2.06	0.44	17.89
_35	537.65	0.01	0.53	0.08	14.49
_36	97.4	0.11	3.8	0.21	21.85
_37	211.74	0.46	2.68	1.11	10
_38	149.82	0.51	1.34	1.18	1.84
_39	16896.63	0.21	1.56	-1	-3.61
_40	18633.05	0.04	3.24	-0.26	12.78
_41	29240.15	0.04	3.24	-0.12	-8.56
_42	79.6	0.02	1.97	0.04	4.64
_43	9989.74	0.03	3.58	0.06	15.9
_44	2503.15	-0.34	-32.68	0.58	61.87
_45	40.22	0.01	1.06	0.04	11.76
_46	274.25	0.02	1.72	0	0.44
_47	11931.25	0	2.22	-1.1	-112.14
_48	13245.7	0	-5.46	0.08	5.31
_49	14	0.02	1.39	0.23	27.25
_50	313.95	0.04	4.36	0.09	9.51

(Continued)

Table 3.7.a: UK - Differences among Liquidity measures for each M&A activity (Continued)

M&A activity	dif_catfat (M)	dif_liquid1_aquirer	dif_liquid2_aquirer	dif_liquid1_target	dif_liquid2_target
_51	60460	0.32	33.87	0.15	21.3
_52	375.15	0.03	1.95	-0.18	-22.11
_53	10358.5	0.06	6.47	0.23	27.24
_54	12930.5	-0.11	-8.31	-0.03	-5.51
_55	110	0	-0.11	0	-0.81
_56	174.51	0.01	1.58	-0.2	-21.31
_57	-741.95	-0.08	-2.5	0.1	12.58
_58	1104.75	0.11	10.62	0.04	4.57
_59	4256.75	0.07	5.5	0.11	15.07
_60	874.05	0.02	2.69	-0.03	-3.88
_61	5869.5	0.04	17.71	0.16	9.76
_62	148.5	-0.01	-1.65	-0.06	-8.31
_63	8357.05	0.05	3.09	-0.21	-18.16
_64	75073.5	0.26	21.34	0.45	48.88
_65	80890.35	0.26	21.34	0.48	50.6
_66	50214.5	0.35	50.92	0.58	71.1
_67	-2727.45	0.05	5.63	0.32	-11.08
_68	-20783.4	0.17	6.55	0.19	7.23
_69	403.25	0.18	8.7	-0.01	-13.02
_70	-22669.15	0.17	6.55	0.2	6.34
_71	20043.25	-0.12	-6.84	0.1	1.3
_72	-4049.85	0.18	-0.53	0.25	3.8
_73	-4891.8	-0.03	-0.71	0.22	-14.4
_74	394.75	-0.05	1.36	-0.07	-10.48
_75	0.3	8.26	4.53	0.08	-2.99

Notes: This table reports for each one of the historical UK bank M&As, the estimated differences with respect to the liquidity creation level produced among each one of the three different liquidity measures, described in Table 3.6.a, between time 't+1' and time 't-1'. As far as the two conventional in the literature measures of liquidity creation (i.e. Liquid1' and 'Liquid2') are concerned we report differences in the level of liquidity creation for both the acquirer and target as well. For brevity purposes numbers in the first column entitled 'M&A activity' correspond to the exact consolidation activity presented in Table 3.5.a. 'M' stands for millions.

Table 3.7.b: Greece - Differences among Liquidity measures for each M&A activity

M&A activity	dif_catfat (M)	dif_liquid1_aquirer	dif_liquid2_aquirer	dif_liquid1_target	dif_liquid2_target
_1	89.01	0.14	15.96	0.08	7.09
_2	126.67	0.03	4.89	0.37	44.52
_3	1690.3	0.07	6.16	0.22	24.75
_4	1057.76	0.01	4.47	0.23	31.92
_5	2836.35	0.04	10.44	-0.08	-7.12
_6	3263.3	0.1	11.14	0.11	13.59
_7	2778.55	0.1	11.14	0.15	18.3
_8	165.1	0.13	9.75	0.09	7.98
_9	6605.95	0.13	13.31	0.02	3.33
_10	1414.45	0.04	8.01	-0.04	-3.66
_11	1678.7	0.04	8.01	-0.21	-14.79
_12	2058.04	0.04	8.01	-0.12	-9.22
_13	664.6	0.05	6.27	0.02	2.02
_14	57.7	-0.05	-24.45	0.03	8.9
_15	2340.75	0.03	1.86	-0.01	-15.47
_16	2035.9	0.04	6	0.09	7.6
_17	6082.15	0.02	1.48	0.13	12.16
_18	69.83	0.03	3.76	0.16	23.16
_19	5819.48	0.02	2.99	0.09	18.23
_20	2831.25	-0.05	-3.94	0.03	2.13
_21	2511.6	-0.05	-3.94	0.05	5.63
_22	306.7	0.07	7.2	0.12	13.81
_23	303.2	0.08	8.97	0.07	9.71
_24	358.35	0.04	2.41	0.04	2.97

Notes: This table reports for each one of the historical Greek bank M&As, the estimated differences with respect to the liquidity creation level produced among each one of the three different liquidity measures, described in Table 3.6.b, between time 't+1' and time 't-1'. As far as the two conventional in the literature measures of liquidity creation (i.e. Liquid1' and 'Liquid2') are concerned we report differences in the level of liquidity creation for both the acquirer and target as well. For brevity purposes numbers in the first column entitled 'M&A activity' correspond to the exact consolidation activity presented in Table 3.5.b. 'M' stands for millions.

Table 3.8.a: UK - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			7	5.1			8.61	5.36			-3.55	-2.71
HHIrev^2			-4.65	-5.03			-5.78	-5.19			2.28	1.96
Uninsured deposits	-5.52	-1.11	-6.99	-0.98	-3.43	-0.56	-4.65	-1.15	-2.17	-2.34	-2.41	-2.35
Bank capital	-3.19	-1.03	-0.37	-0.27	-5.82	-1.38	-0.12	-0.07	-2.95	-2.73	-2.52	-2
Gdp	-0.007	-0.91	-0.003	-1.71	-0.005	-1.02	-0.001	-1.2	-0.004	-0.98	-0.009	-2.74
Public status	0.47	2.49	0.05	0.54	2.34	1.53	0.04	0.48	2.99	1.13	0.61	0.73
Relative size	0.24	5.36	0.32	4.24	0.25	6.05	0.31	5.84	0.19	3.22	0.09	3.03
Intercept	0.8	2.73	2.81	5.58	0.87	2.65	3.34	5.8	0.04	0.16	1.58	1.85
R-squared	0.75		0.81		0.74		0.78		0.55		0.73	
Adj R-squared	0.59		0.66		0.58		0.56		0.36		0.52	
F value	5.47		6.94		3.72		5.09		2.37		4.46	
Observations	75		75		56		56		19		19	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'acquirer' institution in time 't-1' for the UK banking sector during our sample period. The model is

$$((catfat)/(GTA))i,t+1 - ((catfat)/(GTA))i\ ,t-1\ = a0 + a1((UninsuredDeposits)/(GTA))i,t-1 + a2((Bankcapital)/(GTA))i,t-1 + a3Relativesizei,t-1 + a4Publicstatusi,t-1 + a5GDPi,t-1 + \varepsilon i,t$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev\ i,t-1 + a7HHI\text{^}2rev\ i,t-1$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \quad and \quad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.8.b: Greece - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			-3.56	-3.4			-9.28	-2.55			-2.14	-3.47
HHIrev^2			4.95	3.68			5.71	2.45			19.57	0.6
Uninsured deposits	-7.97	-0.09	-4.2	-0.5	-6.51	-0.39	-5.25	-1.52	-3.46	-2.17	5.61	-0.21
Bank capital	-2.17	-3.09	-4.55	-5.18	-3.15	-0.86	-8.03	-1.12	-2.01	-1.97	-2.28	-2.19
Gdp	-0.001	-0.93	-0.008	-0.69	-0.004	-0.22	-0.003	-0.11	-0.001	-0.64	-0.002	-0.73
Public status	0.43	2.59	0.46	2.11	0.17	3.52	0.64	1.81	0.49	2.34	0.39	1.97
Relative size	0.3	3.02	0.21	2.82	0.27	0.79	0.26	0.86	0.38	1.46	0.12	0.46
Intercept	1.23	1.36	2.59	3.72	0.45	0.49	4.51	1.55	2.57	1.22	3.67	0.73
R-squared	0.76		0.89		0.6		0.78		0.85		0.93	
Adj R-squared	0.69		0.84		0.3		0.48		0.7		0.73	
F value	10.85		17.47		4.16		3.17		5.66		4.68	
Observations	24		24		14		14		10		10	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'acquirer' institution in time 't-1' for the Greek banking sector during our sample period. The model is

$$((catfat)/(GTA))i,t+1 - ((catfat)/(GTA))i_{,t-1} = a0 + a1((UninsuredDeposits)/(GTA))i,t-1 + a2((Bankcapital)/(GTA))i,t-1 + a3Relativesizei,t-1 + a4Publicstatusi,t-1 + a5GDPi,t-1 + \varepsilon i,t$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev\ i,t-1 + a7HHI\text{^}2rev\ i,t-1$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \quad \text{and} \quad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.9.a UK - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis
(Independent variables : 'proforma' institution)

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			1.26	3.86			1.54	4.22			-0.55	-2.14
HHIrev^2			-0.51	-2.17			-0.65	-2.45			0.43	2.22
Uninsured deposits	-0.31	-0.08	-1.68	-0.39	-1.09	-0.23	-1.12	-0.23	-7.81	-1.41	-6.99	-0.97
Bank capital	-0.46	-0.34	-3.02	-1.45	-0.72	-0.43	-3.71	-1.3	-1.54	-2.69	-0.84	-2.41
Gdp	-0.003	-0.56	-0.001	-0.39	-0.007	-0.61	-0.005	-0.78	-0.002	-0.44	-0.001	-0.05
Public status	0.46	0.51	0.88	0.27	0.44	0.16	0.86	0.99	0.71	0.34	0.82	0.35
Relative size	0.24	4.74	0.22	6.94	0.24	5.11	0.22	5.36	0	3.01	0.12	3.28
Intercept	0.59	2.15	1.44	3.77	0.59	1.95	1.54	3.8	0.05	0.21	0.21	0.42
R-squared	0.78		0.83		0.75		0.87		0.57		0.68	
Adj R-squared	0.6		0.74		0.67		0.75		0.44		0.45	
F value	3.56		4.89		7.43		3.39		3.33		2.34	
Observations	75		75		56		56		19		19	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'proforma' institution in time 't-1' for the UK banking sector during our sample period. The model is

$$((catfat)/(GTA))i,t+1 - ((catfat)/(GTA))i\ ,t-1\ = a0 + a1((UninsuredDeposits)/(GTA))i,t-1 + a2((Bankcapital)/(GTA))i,t-1 + a3Relativesizei,t-1 + a4Publicstatusi,t-1 + a5GDPi,t-1 + \varepsilon i,t$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev\ i,t-1 + a7HHI\text{^}2rev\ i,t-1$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \qquad and \qquad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.9.b Greece - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis
(Independent variables : 'proforma' institution)

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			-2.26	-3.75			-0.86	-1.97			-2.52	-1.59
HHIrev^2			2.54	3.64			0.62	3.29			0.94	0.84
Uninsured deposits	-1.9	-0.14	-8.64	-0.68	-3.64	-1.56	-3.63	-1.36	-0.48	-3.02	-4.59	-3.63
Bank capital	-1.34	-3.35	-2.73	-2.5	-1.39	-1.52	-0.62	-0.67	-1.4	-3.65	-6.5	-4.66
Gdp	-0.002	-0.06	-0.007	-0.39	-0.001	-1.61	-0.006	-1.21	-0.003	-0.18	-0.004	-1.33
Public status	0.28	2.87	0.46	2.38	0.01	2.37	0.04	2.21	0.38	2.74	0.88	2.47
Relative size	0.43	4.15	0.46	2.74	0.98	1.61	0.84	1.57	0.39	3.26	0.49	5.08
Intercept	0.35	0.31	0.74	0.01	2.56	1.64	1.52	0.99	1.24	0.48	3.62	4.91
R-squared	0.65		0.74		0.68		0.62		0.69		0.79	
Adj R-squared	0.55		0.63		0.43		0.42		0.45		0.57	
F value	6.59		6.48		3.79		3.42		2.83		4.55	
Observations	24		24		14		14		10		10	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'proforma' institution in time 't-1' for the Greek banking sector during our sample period. The model is

$$((catfat)/(GTA))_{i,t+1} - ((catfat)/(GTA))_{i,t-1} = a0 + a1((UninsuredDeposits)/(GTA))_{i,t-1} + a2((Bankcapital)/(GTA))_{i,t-1} + a3Relativesize_{i,t-1} + a4Publicstatus_{i,t-1} + a5GDP_{i,t-1} + \varepsilon_{i,t}$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev_{i,t-1} + a7HHI^{\wedge}2rev_{i,t-1}$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \quad \text{and} \quad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.10.a UK - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis
(Dependent variable: without equity capital)

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			7.19	5.11			8.8	5.34			-4.25	-2.06
HHIrev^2			-4.77	-5.03			-5.91	-5.17			2.69	2.09
Uninsured deposits	-5.8	-1.12	-5.27	-1.02	-3.47	-0.55	-6.81	-1.13	-2.83	-2.42	-2.41	-2.29
Bank capital	-3.31	-1.03	-0.36	-0.25	-6.1	-1.4	-0.16	-0.09	-2.75	-3.54	-2.53	-2.13
Gdp	-0.002	-0.97	-0.004	-1.05	-0.009	-1.09	-0.001	-1.38	-0.005	-0.8	-0.007	-2.45
Public status	0.49	1.51	0.05	0.58	0.41	1.44	0.05	0.5	0.71	1.24	0.1	0.64
Relative size	0.24	5.2	0.32	4.34	0.25	6.93	0.32	5.93	0.32	3.35	0.13	3.39
Intercept	0.85	2.79	2.9	5.62	0.93	2.72	3.44	5.82	0.03	0.12	1.85	2.07
R-squared	0.79		0.86		0.72		0.77		0.53		0.72	
Adj R-squared	0.62		0.76		0.57		0.57		0.36		0.49	
F value	4.42		4.84		3.84		3.51		3.13		3.99	
Observations	75		75		56		56		19		19	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'acquirer' institution in time 't-1' for the UK banking sector during our sample period. Note, that equity capital has been excluded from the calculation of the dependent variable. The model is

$$((catfat)/(GTA))i,t+1 - ((catfat)/(GTA))i_{,t-1} = a0 + a1((UninsuredDeposits)/(GTA))i,t-1 + a2((Bankcapital)/(GTA))i,t-1 + a3Relativesizei,t-1 + a4Publicstatusi,t-1 + a5GDPi,t-1 + \varepsilon i,t$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev\ i,t-1 + a7HHI\text{^}2rev\ i,t-1$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \quad \text{and} \quad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.10.b Greece - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis
(Dependent variable: without equity capital)

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			-4.17	-2.63			-3.45	-4.98			-5.61	-0.53
HHIrev^2			4.91	1.86			3.04	5.05			3.74	0.5
Uninsured deposits	-5.44	-0.7	-5.3	-0.67	-3.54	-0.43	-4.73	-0.95	-7.33	-2.14	-9.9	-2.65
Bank capital	-1.28	-2.45	-3.99	-4.21	-14.3	-0.31	-1.22	-1.05	-0.7	-3.15	-0.38	-2.8
Gdp	-0.004	-1.43	-0.009	-1.37	-0.001	-1.12	-0.003	-2.87	-0.007	-0.95	-0.004	-0.03
Public status	4.47	2.87	4.95	2.81	3.69	2.74	7.96	3.26	4.89	3.21	3.74	2.94
Relative size	0.96	1.94	1.21	2	0.72	0.16	3.19	1.55	0	0.11	0	0.03
Intercept	1.29	0.25	1.28	0.67	2.21	0.61	2.29	4.94	0.51	1.46	2.05	0.68
R-squared	0.46		0.71		0.43		0.92		0.78		0.82	
Adj R-squared	0.3		0.29		0.22		0.52		0.57		0.38	
F value	2.9		2.26		2.36		9.35		3.63		7.52	
Observations	24		24		14		14		10		10	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'acquirer' institution in time 't-1' for the Greek banking sector during our sample period. Note, that equity capital has been excluded from the calculation of the dependent variable. The model is

$$((catfat)/(GTA))i,t+1 - ((catfat)/(GTA))i_{,t-1} = a0 + a1((UninsuredDeposits)/(GTA))i,t-1 + a2((Bankcapital)/(GTA))i,t-1 + a3Relativesizei,t-1 + a4Publicstatusi,t-1 + a5GDPi,t-1 + \varepsilon i,t$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev\ i,t-1 + a7HHI\hat{}2rev\ i,t-1$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \quad and \quad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.11.a: UK - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis (Dependent variable: without equity capital & Independent variables: 'proforma' institution)

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			1.32	3.89			1.6	4.24			-0.46	-2.39
HHIrev^2			-0.54	-2.2			-0.68	-2.47			0.37	2.98
Uninsured deposits	-0.39	-0.09	-1.83	-0.41	1.15	-0.23	-1.19	-0.23	-8.06	-1.64	-7.59	-1.01
Bank capital	-0.45	-0.31	-3.11	-1.04	-0.73	-0.42	-3.84	-1.09	-1.75	-2.16	-0.25	-3.12
Gdp	-0.005	-0.61	-0.009	-0.44	-0.001	-0.66	-0.002	-0.84	-0.007	-0.82	-0.004	-0.49
Public status	0.48	0.54	0.93	1.35	0.46	0.39	0.92	1.06	0.33	0.77	0.57	0.93
Relative size	0.24	5.85	0.22	6.78	0.24	6.96	0.22	5.22	0.21	3.14	0.09	3.9
Intercept	0.64	2.22	1.53	3.86	0.63	2.02	1.63	3.88	0.01	0.05	0.14	0.26
R-squared	0.78		0.85		0.73		0.87		0.56		0.66	
Adj R-squared	0.66		0.73		0.61		0.75		0.43		0.45	
F value	4.51		4.17		3.57		4.67		2.91		2.1	
Observations	75		75		56		56		19		19	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'proforma' institution in time 't-1' for the UK banking sector during our sample period. Note, that equity capital has been excluded from the calculation of the dependent variable. The model is

$$((catfat)/(GTA))_{i,t+1} - ((catfat)/(GTA))_{i,t-1} = a0 + a1((UninsuredDeposits)/(GTA))_{i,t-1} + a2((Bankcapital)/(GTA))_{i,t-1} + a3Relativesize_{i,t-1} + a4Publicstatus_{i,t-1} + a5GDP_{i,t-1} + \varepsilon_{i,t}$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev_{i,t-1} + a7HHI\text{^}2rev_{i,t-1}$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \quad \text{and} \quad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Table 3.11.b: Greece - Financial Fragility Hypothesis vs. Risk Absorption Hypothesis and Deposit Insurance Hypothesis (Dependent variable: without equity capital & Independent variables: 'proforma' institution)

	All-Acquirers				Large-Acquirers				Small-Acquirers			
dif_catfat	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.	Coefficient	b/St.Er.
HHIrev			-3.1	-5.08			-8.3	-2.06			1.93	1.24
HHIrev^2			3.09	2.44			14	3.52			1.56	1.13
Uninsured deposits	-1.96	-0.21	-3.02	-0.12	-1.05	-0.04	-2.09	-0.83	-2.48	-3.64	-1.62	-2.64
Bank capital	-1.51	-2.99	-3.53	-3.81	-3.69	-0.76	-7.4	-0.97	-1.4	-3.86	-1.67	-2.98
Gdp	-0.003	-1.17	-0.006	-0.67	-0.004	-0.49	-0.001	-0.15	-0.008	-0.1	-0.006	-0.7
Public status	4.92	3.61	2.79	2.08	4.91	1.88	0.67	2.39	2.5	2.61	1.43	2.17
Relative size	0.96	2.16	0.96	2.53	0.31	0.4	3.49	0.84	0.36	2.27	0.17	3.45
Intercept	0.47	0.1	0.91	0.02	7	0.33	4.1	0.32	0.25	0.22	0.02	0.02
R-squared	0.55		0.72		0.52		0.89		0.57		0.8	
Adj R-squared	0.33		0.6		0.22		0.77		0.35		0.41	
F value	4.42		5.85		1.75		7.18		1.46		2.05	
Observations	24		24		14		14		10		10	

Notes: This table presents two sets of results -with and without a risk diversification measure- for the ordinary least squares (OLS) regressions where the dependent variable is the difference between the level of liquidity creation of the 'consolidated' institution and of the 'proforma' institution in time 't+1' and the independent variables are related to the 'proforma' institution in time 't-1' for the Greek banking sector during our sample period. Note, that equity capital has been excluded from the calculation of the dependent variable. The model is

$$((catfat)/(GTA))_{i,t+1} - ((catfat)/(GTA))_{i,t-1} = a0 + a1((UninsuredDeposits)/(GTA))_{i,t-1} + a2((Bankcapital)/(GTA))_{i,t-1} + a3Relativesize_{i,t-1} + a4Publicstatus_{i,t-1} + a5GDP_{i,t-1} + \varepsilon_{i,t}$$

and when risk diversification measure is included the model is extended by the following two factors:

$$a6HHIrev_{i,t-1} + a7HHI^{\wedge}2rev_{i,t-1}$$

where 'catfat' represents the liquidity measures based on category including both on and off balance sheet activities for the merged banks at t+1 and for the proforma bank at t-1, uninsured deposits' are the total uninsured deposits of the acquirer bank before the merger and 'Bankcapital' is the amount of equity capital of the acquirer bank before the merger. 'Relativesize' is the ratio of target and acquirer gross total assets (GTA). 'Publicstatus' is a dummy variable with a value of 1 if both acquirers and targets are private and 0 otherwise, and 'GDP' is the real gross domestic product. Herfindahl-Hirschman of revenue 'HHIrev' is the diversification measure and we allow for a nonlinear relationship as well. We compute the diversification measure as follows:

$$HHIrev = ((NON)/(NETOP))^2 + ((NET)/(NETOP))^2 \qquad \text{and} \qquad NETOP = NON + NET$$

where 'NON' is non interest income, 'NET' is net interest income, and 'NETOP' is net operating revenue. Normalization by GTA is necessary to make both the dependent and independent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. Reported statistics are adjusted for heteroskedasticity. Results are reported for all the sample and for only large and small acquirers as well.

Tables 3.12.a: UK - Prospective M&As scenarios

	Financial Institution 1	Financial Institution 2	Financial Institution 3	Difference of Cost Efficiency/Liquidity Creation (M)	
				Up to 2006	Up to 2011
_1	Barclays Bank Plc	Co-operative Bank Plc (The)		4489.43	-2897.36
_2	Barclays Bank Plc	HSBC Bank plc		9767.44	3858.81
_3	Barclays Bank Plc	Lloyds TSB Bank Plc		8640.53	4510.99
_4	Barclays Bank Plc	Royal Bank of Scotland Plc (The)		6032.48	2810.99
_5	Barclays Bank Plc	Sainsbury's Bank plc		1413.19	306.462
_6	Barclays Bank Plc	Santander UK Plc		2399.94	1086.42
_7	Barclays Bank Plc	Standard Chartered Bank		3875.88	1288.35
_8	Barclays Bank Plc	UBS		788.688	246.899
_9	Barclays Bank Plc	AIB		1987.56	680.552
_10	Co-operative Bank Plc (The)	HSBC Bank plc		3354.17	-1204.2
_11	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc		2688.32	-972.787
_12	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)		2974.84	-2228.15
_13	Co-operative Bank Plc (The)	Sainsbury's Bank plc		210.916	-703.142
_14	Co-operative Bank Plc (The)	Santander UK Plc		798.14	-1665.48
_15	Co-operative Bank Plc (The)	Standard Chartered Bank		1002.48	-1736.16
_16	Co-operative Bank Plc (The)	UBS		-388.955	-151.231
_17	Co-operative Bank Plc (The)	AIB		534.937	-380.029
_18	HSBC Bank plc	Lloyds TSB Bank Plc		7622.83	8947.36
_19	HSBC Bank plc	Royal Bank of Scotland Plc (The)		4519.4	5305.89
_20	HSBC Bank plc	Sainsbury's Bank plc		928.56	1538.46
_21	HSBC Bank plc	Santander UK Plc		1648.25	2688.35
_22	HSBC Bank plc	Standard Chartered Bank		2040.59	2525.1
_23	HSBC Bank plc	UBS		670.194	890.585
_24	HSBC Bank plc	AIB		1251.24	2194.57
_25	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)		3448.98	5904.31
_26	Lloyds TSB Bank Plc	Sainsbury's Bank plc		679.143	1979.13
_27	Lloyds TSB Bank Plc	Santander UK Plc		1488.67	4151.29
_28	Lloyds TSB Bank Plc	Standard Chartered Bank		2373.58	3581.86
_29	Lloyds TSB Bank Plc	UBS		304.711	1128.65
_30	Lloyds TSB Bank Plc	AIB		1049.53	2676.09
_31	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc		575.89	962.167
_32	Royal Bank of Scotland Plc (The)	Santander UK Plc		932.95	1682.41
_33	Royal Bank of Scotland Plc (The)	Standard Chartered Bank		1392.81	1876.89
_34	Royal Bank of Scotland Plc (The)	UBS		335.595	811.697
_35	Royal Bank of Scotland Plc (The)	AIB		607.799	1504.32
_36	Sainsbury's Bank plc	Santander UK Plc		1210.39	812.974
_37	Sainsbury's Bank plc	Standard Chartered Bank		1353.42	729.122
_38	Sainsbury's Bank plc	UBS		66.1156	-1697.53
_39	Sainsbury's Bank plc	AIB		489.587	-491.981
_40	Santander UK Plc	Standard Chartered Bank		1906.92	2352.21
_41	Santander UK Plc	UBS		398.14	747.14
_42	Santander UK Plc	AIB		874.72	1065.39
_43	Standard Chartered Bank	UBS		449.905	658.43
_44	Standard Chartered Bank	AIB		943.76	972.761
_45	UBS	AIB		223.02	-525.764
_46	Barclays Bank Plc	Co-operative Bank Plc (The)	HSBC Bank plc	10755.7	1735.81
_47	Barclays Bank Plc	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	9128.09	1363.27
_48	Barclays Bank Plc	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)	8694.68	2061.47
_49	Barclays Bank Plc	Co-operative Bank Plc (The)	Sainsbury's Bank plc	1458.5	-1881.29
_50	Barclays Bank Plc	Co-operative Bank Plc (The)	Santander UK Plc	6589.49	313.061
_51	Barclays Bank Plc	Co-operative Bank Plc (The)	Standard Chartered Bank	7926.39	-138.809
_52	Barclays Bank Plc	Co-operative Bank Plc (The)	UBS	1241.62	-1365.9
_53	Barclays Bank Plc	Co-operative Bank Plc (The)	AIB	3312.04	133.245
_54	Barclays Bank Plc	HSBC Bank plc	Lloyds TSB Bank Plc	14487	6066.36

(Continued)

Tables 3.12.a: UK - Prospective M&As scenarios (Continued)

	Financial Institution 1	Financial Institution 2	Financial Institution 3	Difference of Cost Efficiency/Liquidity Creation (M)	
				Up to 2006	Up to 2011
_55	Barclays Bank Plc	HSBC Bank plc	Royal Bank of Scotland Plc (The)	13889.6	5399.84
_56	Barclays Bank Plc	HSBC Bank plc	Sainsbury's Bank plc	5395.02	3168.77
_57	Barclays Bank Plc	HSBC Bank plc	Santander UK Plc	7640.29	3458.49
_58	Barclays Bank Plc	HSBC Bank plc	Standard Chartered Bank	7771.57	2462.4
_59	Barclays Bank Plc	HSBC Bank plc	UBS	4463.95	1892.12
_60	Barclays Bank Plc	HSBC Bank plc	AIB	6442.57	3168.77
_61	Barclays Bank Plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	12022.5	5643.92
_62	Barclays Bank Plc	Lloyds TSB Bank Plc	Sainsbury's Bank plc	3688.08	3533.77
_63	Barclays Bank Plc	Lloyds TSB Bank Plc	Santander UK Plc	5514.17	4179.5
_64	Barclays Bank Plc	Lloyds TSB Bank Plc	Standard Chartered Bank	6640.01	3859.79
_65	Barclays Bank Plc	Lloyds TSB Bank Plc	UBS	3294.08	1825.4
_66	Barclays Bank Plc	Lloyds TSB Bank Plc	AIB	4924.96	3308.26
_67	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	3905.06	2756.49
_68	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	5915.75	3696.34
_69	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	7199.44	3074.8
_70	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	UBS	3845.07	1194.52
_71	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	AIB	5298.52	2488.63
_72	Barclays Bank Plc	Sainsbury's Bank plc	Santander UK Plc	3760.38	2393.21
_73	Barclays Bank Plc	Sainsbury's Bank plc	Standard Chartered Bank	5176.18	1726.22
_74	Barclays Bank Plc	Sainsbury's Bank plc	UBS	535.716	-187.887
_75	Barclays Bank Plc	Sainsbury's Bank plc	AIB	1383.2	271.778
_76	Barclays Bank Plc	Santander UK Plc	Standard Chartered Bank	4739.11	2819.03
_77	Barclays Bank Plc	Santander UK Plc	UBS	1737.91	784.841
_78	Barclays Bank Plc	Santander UK Plc	AIB	3139.92	1927.01
_79	Barclays Bank Plc	Standard Chartered Bank	UBS	1911.36	316.574
_80	Barclays Bank Plc	Standard Chartered Bank	AIB	3772.46	1541.59
_81	Barclays Bank Plc	UBS	AIB	894.004	-76.4034
_82	Co-operative Bank Plc (The)	HSBC Bank plc	Lloyds TSB Bank Plc	4218.97	2298.03
_83	Co-operative Bank Plc (The)	HSBC Bank plc	Royal Bank of Scotland Plc (The)	3403.62	2215.82
_84	Co-operative Bank Plc (The)	HSBC Bank plc	Sainsbury's Bank plc	1556.14	960.839
_85	Co-operative Bank Plc (The)	HSBC Bank plc	Santander UK Plc	2636.53	1371.35
_86	Co-operative Bank Plc (The)	HSBC Bank plc	Standard Chartered Bank	3109.29	1011.65
_87	Co-operative Bank Plc (The)	HSBC Bank plc	UBS	1148.47	782.498
_88	Co-operative Bank Plc (The)	HSBC Bank plc	AIB	1770.83	716.654
_89	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	3023.1	1918.9
_90	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	Sainsbury's Bank plc	1188.84	1022.23
_91	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	Santander UK Plc	2294.87	1798.92
_92	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	Standard Chartered Bank	2553.02	1476.07
_93	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	UBS	911.601	838.31
_94	Co-operative Bank Plc (The)	Lloyds TSB Bank Plc	AIB	1322.41	798.473
_95	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	1425.94	944.873
_96	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)	Santander UK Plc	2557.93	1341.39
_97	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	2744.84	1181.48
_98	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)	UBS	1170.84	728.67
_99	Co-operative Bank Plc (The)	Royal Bank of Scotland Plc (The)	AIB	2160.23	528.185
_100	Co-operative Bank Plc (The)	Sainsbury's Bank plc	Santander UK Plc	1289.88	761.46
_101	Co-operative Bank Plc (The)	Sainsbury's Bank plc	Standard Chartered Bank	1424.26	900.771
_102	Co-operative Bank Plc (The)	Sainsbury's Bank plc	UBS	69.071	-414.719
_103	Co-operative Bank Plc (The)	Sainsbury's Bank plc	AIB	309.21	-557.194
_104	Co-operative Bank Plc (The)	Santander UK Plc	Standard Chartered Bank	2359.65	1793.04
_105	Co-operative Bank Plc (The)	Santander UK Plc	UBS	1195.48	786.89
_106	Co-operative Bank Plc (The)	Santander UK Plc	AIB	1436.98	364.97
_107	Co-operative Bank Plc (The)	Standard Chartered Bank	UBS	1482.21	604.963
_108	Co-operative Bank Plc (The)	Standard Chartered Bank	AIB	1742.75	303.095

(Continued)

Tables 3.12.a: UK - Prospective M&As scenarios (Continued)

	Financial Institution 1	Financial Institution 2	Financial Institution 3	Difference of Cost Efficiency/Liquidity Creation (M)	
				Up to 2006	Up to 2011
_109	Co-operative Bank Plc (The)	UBS	AIB	625.16	-278.14
_110	HSBC Bank plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	10049	7226.36
_111	HSBC Bank plc	Lloyds TSB Bank Plc	Sainsbury's Bank plc	2699.46	3910.95
_112	HSBC Bank plc	Lloyds TSB Bank Plc	Santander UK Plc	5058.07	4724.22
_113	HSBC Bank plc	Lloyds TSB Bank Plc	Standard Chartered Bank	5718.21	4218.66
_114	HSBC Bank plc	Lloyds TSB Bank Plc	UBS	2335.89	2189.53
_115	HSBC Bank plc	Lloyds TSB Bank Plc	AIB	4348.78	3897.12
_116	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	3654.9	3128.26
_117	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	5007.49	4311.93
_118	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	6697.58	3859.04
_119	HSBC Bank plc	Royal Bank of Scotland Plc (The)	UBS	3513.4	2773.76
_120	HSBC Bank plc	Royal Bank of Scotland Plc (The)	AIB	4087.2	2964.71
_121	HSBC Bank plc	Sainsbury's Bank plc	Santander UK Plc	3155.89	2608.03
_122	HSBC Bank plc	Sainsbury's Bank plc	Standard Chartered Bank	4537.68	2110.25
_123	HSBC Bank plc	Sainsbury's Bank plc	UBS	415.052	107.967
_124	HSBC Bank plc	Sainsbury's Bank plc	AIB	1016.56	575.634
_125	HSBC Bank plc	Santander UK Plc	Standard Chartered Bank	4144.9	3546.13
_126	HSBC Bank plc	Santander UK Plc	UBS	1394.55	962.884
_127	HSBC Bank plc	Santander UK Plc	AIB	2748.84	2111.07
_128	HSBC Bank plc	Standard Chartered Bank	UBS	1446.43	822.731
_129	HSBC Bank plc	Standard Chartered Bank	AIB	3177	2214.5
_130	HSBC Bank plc	UBS	AIB	559.517	356.134
_131	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	3407.75	3222.34
_132	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	4788.58	4536.75
_133	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	5768.96	4752.82
_134	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	UBS	3195.71	2939.58
_135	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	AIB	3739.37	3400.01
_136	Lloyds TSB Bank Plc	Sainsbury's Bank plc	Santander UK Plc	2947.96	2715.75
_137	Lloyds TSB Bank Plc	Sainsbury's Bank plc	Standard Chartered Bank	3662.47	3236.15
_138	Lloyds TSB Bank Plc	Sainsbury's Bank plc	UBS	275.4	189.244
_139	Lloyds TSB Bank Plc	Sainsbury's Bank plc	AIB	894.713	724.48
_140	Lloyds TSB Bank Plc	Santander UK Plc	Standard Chartered Bank	3477.41	4204.75
_141	Lloyds TSB Bank Plc	Santander UK Plc	UBS	1197.87	1094.78
_142	Lloyds TSB Bank Plc	Santander UK Plc	AIB	2397.17	2224.87
_143	Lloyds TSB Bank Plc	Standard Chartered Bank	UBS	1215.01	976.8
_144	Lloyds TSB Bank Plc	Standard Chartered Bank	AIB	3059.93	2802.64
_145	Lloyds TSB Bank Plc	UBS	AIB	415.46	389.825
_146	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	Santander UK Plc	2935.68	2549.27
_147	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	Standard Chartered Bank	3928.58	2709.86
_148	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	UBS	369.371	88.5841
_149	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	AIB	925.047	669.768
_150	Royal Bank of Scotland Plc (The)	Santander UK Plc	Standard Chartered Bank	3904.5	3928.81
_151	Royal Bank of Scotland Plc (The)	Santander UK Plc	UBS	1116.99	824.157
_152	Royal Bank of Scotland Plc (The)	Santander UK Plc	AIB	2422.71	2073.36
_153	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	UBS	1337.91	791.517
_154	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	AIB	3203.31	2579.35
_155	Royal Bank of Scotland Plc (The)	UBS	AIB	914.273	236.796
_156	Sainsbury's Bank plc	Santander UK Plc	Standard Chartered Bank	1298.22	1010.26
_157	Sainsbury's Bank plc	Santander UK Plc	UBS	664.17	500.88
_158	Sainsbury's Bank plc	Santander UK Plc	AIB	998.74	688.12
_159	Sainsbury's Bank plc	Standard Chartered Bank	UBS	748.78	414.789
_160	Sainsbury's Bank plc	Standard Chartered Bank	AIB	1245.98	550.14
_161	Sainsbury's Bank plc	UBS	AIB	538.313	-190.811

(Continued)

Tables 3.12.a: UK - Prospective M&As scenarios (Continued)

	Financial Institution 1	Financial Institution 2	Financial Institution 3	Difference of Cost Efficiency/Liquidity Creation (M)	
				Up to 2006	Up to 2011
_162	Santander UK Plc	Standard Chartered Bank	UBS	1232.15	972.024
_163	Santander UK Plc	Standard Chartered Bank	AIB	2824.41	2070.4
_164	Santander UK Plc	UBS	AIB	603.48	300.787
_165	Standard Chartered Bank	UBS	AIB	701.66	198.49

Notes: This tables presents for each prospective M&A scenario in the UK banking sector, the difference in the estimated level of cost efficiency associated with the level of liquidity creation 'between the potentially "consolidated' institution and of the 'proforma' institution both in 2006 (i.e. pre crisis scenario) and in 2011 (i.e. post crisis scenario). 'M' stands for millions. The level of of liquidity creation is computed by the model described in table 3.8.a, whereas the level of cost efficiency is estimated by the following model:

$$lnTC,it=lnC(y\{it\},w\{it\},T,E\{it\};\beta)+u\{it\}+v\{it\}$$

where subscripts i=1,....N stand for each financial institution (i.e. each M&A activity), T=.year1,year2...,final-year, and indicates a time trend and is included in each specification to allow for technological change, using both linear and quadratic (i.e. T and T²) respectively. TC_{it} is individual bank total cost; y_{it} and w_{it} indicate vectors of output and input prices; we specify equity (E) as a quasi-fixed input to control for differences in risk preferences, which may arise due to regulation, financial distress, or informational asymmetries; β is a vector of parameters to be estimated. The two-sided random error term v_{it} is assumed to be independent of the non-negative cost efficiency variable u_{it} and is assumed to follow a symmetric normal distribution around the frontier and ui, accounts for the firm's inefficiency and is assumed to follow a half-normal distribution.

Tables 3.12.b: Greece - Recent & Prospective M&As scenarios

	Financial Institutions	Difference of Cost Efficiency/Liquidity Creation (M)	
	Exist	Up to 2006	Up to 2011
_1	ALPHA-EMPORIKI	4536.91	1395.63
_2	ETHNIKI-FBB	3048.13	2610.53
_3	ETHNIKI-PROBANK	3564.84	3290.63
_4	ETHNIKI-FFB-PROBANK	7648.84	4070.01
_5	PIRAEUS-ATE	4329.05	-1786.36
_6	PIRAEUS-GENIKI	3581.85	-1371.03
_7	PIRAEUS-MARFIN_EGNATIA	3143.06	1506.42
_8	PIRAEUS-MILLENIUM	2246.28	746.06
_9	PIRAEUS-ATE-GENIKI	3267.81	-1789.74
_10	PIRAEUS-ATE-MARFIN_EGANTIA	2877.77	-814.13
_11	PIRAEUS-ATE-MILLENIUM	2029.82	1280.5
_12	PIRAEUS-GENIKI-MARFIN_EGNATIA	2663.83	-587.52
_13	PIRAEUS-GENIKI-MILLENIUM	1480.23	418.15
_14	PIRAEUS-MARFIN_EGANTIA-MILLENIUM	1082.37	1155.13
_15	PIRAEUS-ATE-GENIKI-MARFIN_EGANTIA	1820.57	-441.66
_16	PIRAEUS-ATE-GENIKI-MILLENIUM	1363.2	-1549.08
_17	PIRAEUS-GENIKI-MARFIN_EGANATIA-MILLENIUM	851.44	-199.96
_18	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM	445.36	-617.14
_19	EUROBANK_PROTON	1609.42	-1014.34
_20	EUROBANK_TT_HELLENIC	2283.55	1873.8
_21	EUROBANK-PROTON_TT-HELLENIC	4086.79	-473.38
	Could Exist		
_22	ALPHA-ATTICA	3734.16	1878.05
_23	ALPHA-AEGEAN	1528.02	1665.81
_24	ALPHA-PANELLINIA	1525.16	1084.44
_25	ALPHA-PANCREATAN	2221.55	1792.08
_26	ETHNIKI-ATTICA	7991.02	2907.92
_27	ETHNIKI-AEGEAN	4133.74	4394.21
_28	ETHNIKI-PANELLINIA	3950.47	2950.33
_29	ETHNIKI-PANCREATAN	4796.59	4097.23
_30	PIRAEUS-ATTICA	3420.91	1448.64
_31	PIRAEUS-AEGEAN	2252.81	2276.18
_32	PIRAEUS-PANELLINIA	1636.99	1563.83
_33	PIREAUS-PANCREATAN	2813.28	2463.36
_34	EUROBANK-ATTICA	3215.15	1575.06
_35	EUROBANK-AEGEAN	1658.64	1720.31
_36	EUROBANK-PANELLINIA	1369.44	1019.9
_37	EUROBANK-PANCRETAN	1904.32	1525.53
	Potential		
_38	ALPHA-EMPORIKI-ATTICA	4314.91	-1427.84
_39	ALPHA-EMPORIKI-AEGEAN	2601.49	2425.53
_40	ALPHA-EMPORIKI-PANELLINIA	2121.12	1662.8
_41	ALPHA-EMPORIKI-PANCRETAN	2961.47	2372.92
_42	ALPHA-EMPORIKI-ATTICA-AEGEAN	3360.72	-2110.76
_43	ALPHA-EMPORIKI-ATTICA-PANELLINIA	2795.48	-1580.62
_44	ALPHA-EMPORIKI-ATTICA-PANCRETAN	3847.96	-2175.7
_45	ALPHA-EMPORIKI-AEGEAN-PANELLINIA	2355.8	1894.45
_46	ALPHA-EMPORIKI-AEGEAN-PANCRETAN	2820.8	2706.03
_47	ALPHA-EMPORIKI-PANELLINIA-PANCRETAN	2210.56	-790.98
_48	ALPHA-EMPORIKI-ATTICA-AEGEAN-PANELLINIA	1912.35	-1856.47
_49	ALPHA-EMPORIKI-ATTICA-AEGEAN-PANCRETAN	2749.02	-1659.72
_50	ALPHA-EMPORIKI-ATTICA-PANELLINIA-PANCRETAN	1753.17	-2337.69

(Continued)

Tables 3.12.b: Greece - Recent & Prospective M&As scenarios (Continued)

	Financial Institutions	Difference of Cost Efficiency/Liquidity Creation (M)	
	Potential	Up to 2006	Up to 2011
_51	ALPHA-EMPORIKI-AEGEAN-PANELLINIA-PANCRETAN	2281.07	-1185.95
_52	ALPHA-EMPORIKI-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	1310.17	-2740.43
_53	ETHNIKI-FFB-PROBANK-ATTICA	10080.73	-3249.13
_54	ETHNIKI-FFB-PROBANK-AEGEAN	6667.93	2793.67
_55	ETHNIKI-FFB-PROBANK-PANELLINIA	6079.13	-2594.83
_56	ETHNIKI-FFB-PROBANK-PANCRETAN	8238.43	2361.83
_57	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN	7776.37	-2199.33
_58	ETHNIKI-FFB-PROBANK-ATTICA-PANELLINIA	5576.37	-3399.33
_59	ETHNIKI-FFB-PROBANK-ATTICA-PANCRETAN	7424.69	-2273.31
_60	ETHNIKI-FFB-PROBANK-AEGEAN-PANELLINIA	5849.55	1299.73
_61	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	5760.45	1943.1
_62	ETHNIKI-FFB-PROBANK-PANELLINIA-PANCRETAN	4314.75	1119.21
_63	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN-PANELLINIA	2846.91	-2442.49
_64	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN-PANCRETAN	3389.78	-1592.54
_65	ETHNIKI-FFB-PROBANK-ATTICA-PANELLINIA-PANCRETAN	2432.52	-2792.54
_66	ETHNIKI-FFB-PROBANK-AEGEAN-PANELLINIA-PANCRETAN	2016.02	-691.78
_67	ETHNIKI-FFB-PROBANK-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	1876.07	-1494.82
_68	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA	290.11	-1121.52
_69	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-AEGEAN	75.41	-210.52
_70	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-PANELLINIA	-150.75	-864.81
_71	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-PANCRETAN	388.77	-469.67
_72	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-AEGEAN	247.85	-590.82
_73	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-PANELLINIA	73.36	-1719.65
_74	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-PANCRETAN	123.97	-972.19
_75	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-AEGEAN-PANELLINIA	9.86	78.21
_76	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-AEGEAN-PANCRETAN	27.2	471.41
_77	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-PANELLINIA-PANCRETAN	54.5	-7154.69
_78	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-AEGEAN-PANELLINIA	26.78	-976.48
_79	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-AEGEAN-PANCRETAN	82.6	-798.21
_80	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-PANELLINIA-PANCRETAN	86.17	-1194.72
_81	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-AEGEAN-PANELLINIA-PANCRETAN	6.42	-583.74
_82	PIRAEUS-ATE-GENIKI-MARFIN_EGNATIA-MILLENIUM-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	-22.1	-1476.89
_83	EUROBANK-PROTON_TT-HELLENIC-ATTICA	5828.47	-1298.01
_84	EUROBANK-PROTON_TT-HELLENIC-AEGEAN	4373.08	848.77
_85	EUROBANK-PROTON_TT-HELLENIC-PANELLINIA	4152.24	-781.05
_86	EUROBANK-PROTON_TT-HELLENIC-PANCRETAN	4794.49	630.17
_87	EUROBANK-PROTON_TT-HELLENIC-ATTICA-AEGEAN	4495.53	-729.73
_88	EUROBANK-PROTON_TT-HELLENIC-ATTICA-PANELLINIA	4364.78	-1402.83
_89	EUROBANK-PROTON_TT-HELLENIC-ATTICA-PANCRETAN	4536.67	-926.76
_90	EUROBANK-PROTON_TT-HELLENIC-AEGEAN-PANELLINIA	3853.25	-339.92
_91	EUROBANK-PROTON_TT-HELLENIC-AEGEAN-PANCRETAN	3547.73	559.66
_92	EUROBANK-PROTON_TT-HELLENIC-PANELLINIA-PANCRETAN	2635.21	-525.14
_93	EUROBANK-PROTON_TT-HELLENIC-ATTICA-AEGEAN-PANELLINIA	1701.94	-1076.74
_94	EUROBANK-PROTON_TT-HELLENIC-ATTICA-AEGEAN-PANCRETAN	2335.16	-673.44
_95	EUROBANK-PROTON_TT-HELLENIC-ATTICA-PANELLINIA-PANCRETAN	1576.19	-1480.27
_96	EUROBANK-PROTON_TT-HELLENIC-AEGEAN-PANELLINIA-PANCRETAN	1050.33	-422.02
_97	EUROBANK-PROTON_TT-HELLENIC-ATTICA-AEGEAN-PANELLINIA-PANCRETAN	284.18	-786.07

(Continued)

Tables 3.12.b: Greece - Recent & Prospective M&As scenarios (Continued)

	Financial Institutions	Difference of Cost Efficiency/Liquidity Creation (M)	
	Potential	Up to 2006	Up to 2011
_98	ATTIKA-AEGEAN	886.97	-72.51
_99	ATTICA-PANELLINIA	653.38	-467.4
_100	ATTICA-PANCRETAN	1006.92	-186.53
_101	AEGEAN-PANCRETAN	349.94	242.28
_102	PANELLINIA-PANCRETAN	281.74	-234.74
_103	ATTICA-AEGEAN-PANELLINIA	1168.66	-373.44
_104	ATTICA-AEGEAN-PANCRETAN	1397.84	-166.16
_105	AEGEAN-PANELLINIA-PANCRETAN	692.39	21.68
_106	ATTICA-AEGEAN-PANELLINIA-PANCRETAN	1051.49	-207.63

Notes: This tables presents for each recent and prospective M&A scenario in the Greek banking sector, the difference in the estimated level of cost efficiency associated with the level of liquidity 'creation 'between the potentially "consolidated' institution and of the 'proforma' institution both in 2006 (i.e. pre crisis scenario) and in 2011 (i.e. post crisis scenario). 'M' stands for millions. The level of of liquidity creation is computed by the model described in table 3.8.b, whereas the level of cost efficiency is estimated by the following model:

$$lnTC,it=lnC(y\{it\},w\{it\},T,E\{it\} ;\beta)+u\{it\}+v\{it\}$$

where subscripts i=1,....N stand for each financial institution (i.e. each M&A activity), T=.year1,year2...,final-year, and indicates a time trend and is included in each specification to allow for technological change, using both linear and quadratic (i.e. T and T²) respectively. TC_{it} is individual bank total cost; y_{it} and w_{it} indicate vectors of output and input prices; we specify equity (E) as a quasi-fixed input to control for differences in risk preferences, which may arise due to regulation, financial distress, or informational asymmetries; β is a vector of parameters to be estimated. The two-sided random error term v_{it} is assumed to be independent of the non-negative cost efficiency variable u_{it} and is assumed to follow a symmetric normal distribution around the frontier and ui, accounts for the firm's inefficiency and is assumed to follow a half-normal distribution.

Table 3.13.a: Table: UK - Unit root analysis of the variables used in the stress test scenario

	Constant and Trend included in the model					
	d Catfat		Ceff		d TPL	
Method	Statistic	P-value	Statistic	P-value	Statistic	P-value
ADF - Fisher Chisquare	59.2898	0,000	13.3426	0,000	9.1028	0,000
PP - Fisher Chisquare	86.4639	0,000	22.6894	0,000	14.8929	0,000
	d GDP		d Real EER		d 3M Tbill	
Method	Statistic	P-value	Statistic	P-value	Statistic	P-value
ADF - Fisher Chisquare	124.9676	0,000	36.1855	0,000	37.0507	0,000
PP - Fisher Chisquare	211.5184	0,000	61.4127	0,000	64.7155	0,000

Notes: This table reports the empirical estimates of the unit root analysis on the variables that were considered in the panel vector autoregressive system (PVAR) as far as the UK banking sector is concerned. Specifically, 'd Catfat', 'd TPL', 'd GDP', 'd Real EER' and 'd 3M Tbill' refer to the first differences of Liquidity Creation, Total Problem Loans, Gdp Growth Rate, Real Effective Exchange Rate and Three month treasury bill rate respectively, while 'Ceff' refers to the cost efficiency score.

Table 3.13.b: Table: Greece - Unit root analysis of the variables used in the stress test scenario

	Constant and Trend included in the model					
	d Catfat		Ceff		d TPL	
Method	Statistic	P-value	Statistic	P-value	Statistic	P-value
ADF - Fisher Chisquare	59.2898	0,000	13.3426	0,000	9.1028	0,000
PP - Fisher Chisquare	86.4639	0,000	22.6894	0,000	14.8929	0,000
	d GDP		d Real EER		d 3M Tbill	
Method	Statistic	P-value	Statistic	P-value	Statistic	P-value
ADF - Fisher Chisquare	124.9676	0,000	36.1855	0,000	37.0507	0,000
PP - Fisher Chisquare	211.5184	0,000	61.4127	0,000	64.7155	0,000

Notes: This table reports the empirical estimates of the unit root analysis on the variables that were considered in the panel vector autoregressive system (PVAR) as far as the Greek banking sector is concerned. Specifically, 'd Catfat', 'd TPL', 'd GDP', 'd Real EER' and 'd 3M Tbill' refer to the first differences of Liquidity Creation, Total Problem Loans, Gdp Growth Rate, Real Effective Exchange Rate and Three month treasury bill rate respectively, while 'Ceff' refers to the cost efficiency score.

Table 3.14: Liquidity Creation - Variance Decompositions

	d_catfat2	ceff	d_TPL2	dGdP	d_Real_EER	d_3M_Tbill
UK						
10	0.78493406	0.04171584	0.11601967	0.01612504	0.00167409	0.03953131
20	0.78493398	0.04171584	0.11601967	0.01612504	0.00167412	0.03953135
30	0.78493398	0.04171584	0.11601967	0.01612504	0.00167412	0.03953135
Greece BEFORE the recent consolidation activity						
	d_catfat2	ceff	d_TPL2	dGdP	d_Real_EER	d_3M_Tbill
10	0.80889784	0.0134512	0.13678105	0.00436625	0.00224342	0.03426025
20	0.80887736	0.01346604	0.13678158	0.00436657	0.00224787	0.03426058
30	0.80887619	0.01346662	0.13678185	0.00436659	0.00224809	0.03426066
Greece AFTER the recent consolidation activity						
	d_catfat2	ceff	d_TPL2	dGdP	d_Real_EER	d_3M_Tbill
10	0.76155485	0.00393531	0.19510167	0.00033914	0.00004538	0.03902365
20	0.761545	0.00395142	0.19509328	0.00033949	0.00004988	0.03902093
30	0.7615442	0.00395189	0.19509325	0.0003395	0.00005011	0.03902105

This table reports the variance decompositions of Liquidity Creation with respect to a Bank, a Macroeconomic and a Financial shock, deriving from the panel vector autoregressive (PVAR) system for both the UK and Greek baseline scenario where there is no bank consolidation activity in the sector and the additional baseline scenario that indicates the current conditions of the Greek banking system after the recent wave of Greek banks' M&As. Specifically, 'd Catfat2', 'd TPL', 'd GDP', 'd Real EER' and d 3M Tbill' refer to the first differences of Liquidity Creation, Total Problem Loans (i.e. Bank shock), Gdp Growth Rate (i.e. Macroeconomic shock), Real Effective Exchange Rate (i.e. Financial shock) and Three month treasury bill rate (i.e. Financial shock) respectively, while 'Ceff' refers to the cost efficiency score (i.e. Bank shock). The total effect accumulated is reported over 10, 20 and 30 years.

Table 3.15: Cost Efficiency - Variance Decompositions

				UK			
		d_catfat2	ceff	d_TPL2	dGdP	d_Real_EER	d_3M_Tbill
ceff	10	0.21495877	0.31843069	0.31431747	0.01811352	0.05647597	0.07770357
ceff	20	0.21332242	0.31343812	0.31877367	0.01763171	0.05847431	0.07835977
ceff	30	0.21324806	0.31321167	0.318976	0.01760985	0.05856497	0.07838946
				Greece BEFORE the recent consolidation activity			
		d_catfat2	ceff	d_TPL2	dGdP	d_Real_EER	d_3M_Tbill
ceff	10	0.13958527	0.42648238	0.24301	0.02160677	0.0769042	0.09241137
ceff	20	0.13438309	0.42511087	0.24650601	0.0213031	0.0804462	0.09225072
ceff	30	0.13412232	0.42503868	0.24668334	0.02128799	0.08062535	0.09224233
				Greece AFTER the recent consolidation activity			
		d_catfat2	ceff	d_TPL2	dGdP	d_Real_EER	d_3M_Tbill
ceff	10	0.16024421	0.31277699	0.28216	0.01264193	0.11817795	0.11399892
ceff	20	0.15620581	0.31057	0.28393777	0.01248	0.12229427	0.11451215
ceff	30	0.15605264	0.31014	0.28434267	0.01247369	0.12246123	0.11452977

This table reports the variance decompositions of Cost Efficiency with respect to a Bank, a Macroeconomic and a Financial shock, deriving from the panel vector autoregressive (PVAR) system for both the UK and Greek baseline scenario where there is no bank consolidation activity in the sector and the additional baseline scenario that indicates the current conditions of the Greek banking system after the recent wave of Greek banks' M&As. Specifically, 'd Catfat2', 'd TPL', 'd GDP', 'd Real EER' and d 3M Tbill' refer to the first differences of Liquidity Creation, Total Problem Loans (i.e. Bank shock), Gdp Growth Rate (i.e. Macroeconomic shock), Real Effective Exchange Rate (i.e. Financial shock) and Three month treasury bill rate (i.e. Financial shock) respectively, while 'Ceff' refers to the cost efficiency score (i.e. Bank shock). The total effect accumulated is reported over 10, 20 and 30 years.

Table 3.16.a: UK: Half - Life & Total Effect after a Macroeconomic shock

				Half Life (years)	%)
		Banking System without any M&A		1.651	8.531
		Banking System with Potential M&A			
	Financial Institution 1	Financial Institution 2	Financial Institution 3		
_1	HSBC Bank plc	Lloyds TSB Bank Plc		1.411	5.262
_2	HSBC Bank plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	1.415	5.574
_3	Barclays Bank Plc	HSBC Bank plc	Lloyds TSB Bank Plc	1.274	4.348
_4	HSBC Bank plc	Royal Bank of Scotland Plc (The)		1.327	4.912
_5	HSBC Bank plc	Lloyds TSB Bank Plc	Santander UK Plc	1.345	4.846
_6	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	1.317	4.774
_7	HSBC Bank plc	Lloyds TSB Bank Plc	Standard Chartered Bank	1.347	4.628
_8	Royal Bank of Scotland Plc (The)	Santander UK Plc	Standard Chartered Bank	1.482	7.156
_9	Barclays Bank Plc	HSBC Bank plc		1.289	4.782
_10	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	1.386	6.141
_11	HSBC Bank plc	Santander UK Plc	Standard Chartered Bank	1.267	4.431
_12	Barclays Bank Plc	HSBC Bank plc	Santander UK Plc	1.243	4.317
_13	Barclays Bank Plc	HSBC Bank plc	AIB	1.389	4.943
_14	HSBC Bank plc	Royal Bank of Scotland Plc (The)	AIB	1.416	5.372
_15	Barclays Bank Plc	Santander UK Plc	Standard Chartered Bank	1.273	4.371
_16	HSBC Bank plc	Santander UK Plc		1.297	4.782
_17	HSBC Bank plc	Sainsbury's Bank plc	Santander UK Plc	1.304	5.246
_18	HSBC Bank plc	Standard Chartered Bank		1.301	5.379
_19	Barclays Bank Plc	HSBC Bank plc	Standard Chartered Bank	1.251	4.387
_20	Santander UK Plc	Standard Chartered Bank		1.342	5.038
_21	HSBC Bank plc	Standard Chartered Bank	AIB	1.318	5.176
_22	HSBC Bank plc	AIB		1.408	6.046
_23	Barclays Bank Plc	Santander UK Plc	AIB	1.423	6.161
_24	Barclays Bank Plc	Co-operative Bank Plc (The)	HSBC Bank plc	1.501	6.895
_25	Barclays Bank Plc	Standard Chartered Bank	AIB	1.487	6.016
_26	HSBC Bank plc	Sainsbury's Bank plc		1.546	6.947
_27	Barclays Bank Plc	Standard Chartered Bank		1.304	4.864
_28	Barclays Bank Plc	Santander UK Plc		1.287	4.643
_29	Co-operative Bank Plc (The)	HSBC Bank plc	Standard Chartered Bank	1.517	6.432
_30	Sainsbury's Bank plc	Santander UK Plc	Standard Chartered Bank	1.476	6.214
_31	Standard Chartered Bank	AIB		1.502	6.249
_32	HSBC Bank plc	UBS	AIB	1.604	7.943

This table demonstrate those UK prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after a Macroeconomic shock, with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities.

Table 3.16.b: Greece: Half - Life & Total Effect after a Macroeconomic shock

		Half Life (years)	Total Effect (abs. values %)
	Banking system *Before* recent consolidation activity without any M&A	1.914	17.165
	Banking system *Before* recent consolidation activity with Potential M&A		
_1	ETHNIKI-AEGEAN	1.598	11.745
_2	ETHNIKI-PANCREATAN	1.645	12.186
_3	ETHNIKI-FFB-PROBANK	1.481	10.946
_4	ETHNIKI-PROBANK	1.694	12.357
_5	ETHNIKI-FFB-PROBANK-AEGEAN	1.254	9.864
_6	ALPHA-EMPORIKI-AEGEAN-PANCRETAN	1.416	10.618
_7	ETHNIKI-FBB	1.671	12.684
_8	PIREAUS-PANCREATAN	1.716	14.391
_9	ALPHA-EMPORIKI-AEGEAN	1.487	11.493
_10	ALPHA-EMPORIKI-PANCRETAN	1.569	11.717
_11	ETHNIKI-FFB-PROBANK-PANCRETAN	1.347	10.468
_12	PIRAEUS-AEGEAN	1.764	14.849
_13	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	1.378	11.064
_14	ALPHA-PANCREATAN	1.617	12.397
_15	EUROBANK-AEGEAN	1.744	14.622
_16	ALPHA-AEGEAN	1.571	12.078
_17	ALPHA-EMPORIKI	1.643	12.755
	Banking system *After* recent consolidation activity without any M&A	2.682	21.597
	Banking system *After* recent consolidation activity with Potential M&A		
_1	ETHNIKI-FFB-PROBANK	2.316	14.699
_2	ETHNIKI-FFB-PROBANK-AEGEAN	2.186	13.937
_3	ALPHA-EMPORIKI-AEGEAN-PANCRETAN	2.484	17.418
_4	ALPHA-EMPORIKI-AEGEAN	2.379	15.522
_5	ALPHA-EMPORIKI-PANCRETAN	2.461	16.691
_6	ETHNIKI-FFB-PROBANK-PANCRETAN	2.287	14.462
_7	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	2.428	15.923
_8	ALPHA-EMPORIKI	2.583	18.461

This table demonstrate those Greek prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after a Macroeconomic shock, with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities. Results are reported for both states of the Greek banking sector, i.e. with and without accounting for the recent wave of M&As.

Table 3.17.a: UK: Half - Life & Total Effect after a Financial shock

	Financial Institution 1	Financial Institution 2	Financial Institution 3	Half Life (years)	Total Effect (abs.values %)
		Banking System without any M&A		0.963	4.234
		Banking System with Potential M&A			
_1	HSBC Bank plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	0.687	2.247
_2	Barclays Bank Plc	HSBC Bank plc	Lloyds TSB Bank Plc	0.574	2.695
_3	Barclays Bank Plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	0.863	3.473
_4	Barclays Bank Plc	HSBC Bank plc	Royal Bank of Scotland Plc (The)	0.714	2.597
_5	HSBC Bank plc	Royal Bank of Scotland Plc (The)		0.698	2.781
_6	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	0.781	3.429
_7	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	0.576	2.754
_8	Lloyds TSB Bank Plc	Santander UK Plc	Standard Chartered Bank	0.639	3.048
_9	Barclays Bank Plc	Lloyds TSB Bank Plc	Santander UK Plc	0.746	3.105
_10	Royal Bank of Scotland Plc (The)	Santander UK Plc	Standard Chartered Bank	0.679	3.014
_11	HSBC Bank plc	Lloyds TSB Bank Plc	Sainsbury's Bank plc	0.708	3.343
_12	HSBC Bank plc	Lloyds TSB Bank Plc	AIB	0.682	3.152
_13	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	0.614	2.874
_14	Barclays Bank Plc	HSBC Bank plc		0.579	2.524
_15	HSBC Bank plc	Santander UK Plc	Standard Chartered Bank	0.537	2.246
_16	Barclays Bank Plc	HSBC Bank plc	Santander UK Plc	0.528	2.197
_17	Barclays Bank Plc	Lloyds TSB Bank Plc	AIB	0.768	3.476
_18	Lloyds TSB Bank Plc	Sainsbury's Bank plc	Standard Chartered Bank	0.867	3.943
_19	Barclays Bank Plc	HSBC Bank plc	Sainsbury's Bank plc	0.604	2.884
_20	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	0.691	3.217
_21	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	0.637	3.078
_22	Barclays Bank Plc	Santander UK Plc	Standard Chartered Bank	0.581	2.576
_23	HSBC Bank plc	Royal Bank of Scotland Plc (The)	UBS	0.701	3.314
_24	HSBC Bank plc	Santander UK Plc		0.591	2.768
_25	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	Santander UK Plc	0.849	3.716
_26	HSBC Bank plc	Standard Chartered Bank		0.608	2.943
_27	Barclays Bank Plc	HSBC Bank plc	Standard Chartered Bank	0.536	2.297
_28	Barclays Bank Plc	Sainsbury's Bank plc	Santander UK Plc	0.673	3.946
_29	Santander UK Plc	Standard Chartered Bank		0.624	3.072
_30	Lloyds TSB Bank Plc	Santander UK Plc	AIB	0.819	3.881
_31	HSBC Bank plc	Standard Chartered Bank	AIB	0.638	3.112
_32	HSBC Bank plc	Santander UK Plc	AIB	0.603	2.671
_33	HSBC Bank plc	Sainsbury's Bank plc	Standard Chartered Bank	0.657	3.487
_34	Barclays Bank Plc	Santander UK Plc	AIB	0.679	3.187
_35	Barclays Bank Plc	HSBC Bank plc	UBS	0.619	2.873
_36	Royal Bank of Scotland Plc (The)	Standard Chartered Bank		0.703	3.472
_37	Co-operative Bank Plc (The)	Santander UK Plc	Standard Chartered Bank	0.826	4.137
_38	Barclays Bank Plc	Co-operative Bank Plc (The)	HSBC Bank plc	0.736	3.768
_39	Barclays Bank Plc	Sainsbury's Bank plc	Standard Chartered Bank	0.649	3.348
_40	Royal Bank of Scotland Plc (The)	Santander UK Plc		0.751	3.794
_41	Barclays Bank Plc	Standard Chartered Bank		0.614	3.173
_42	Barclays Bank Plc	Santander UK Plc		0.597	3.067
_43	Santander UK Plc	AIB		0.649	3.581
_44	Co-operative Bank Plc (The)	HSBC Bank plc	Standard Chartered Bank	0.734	3.974
_45	Standard Chartered Bank	AIB		0.711	3.618
_46	Co-operative Bank Plc (The)	HSBC Bank plc	Sainsbury's Bank plc	0.753	3.816

(Continued)

Table 3.17.a: UK: Half - Life & Total Effect after a Financial shock (Continued)

				Half Life (years)	Total Effect (abs.values %)
		Banking System without any M&A		0.963	4.234
		Banking System with Potential M&A			
	Financial Institution 1	Financial Institution 2	Financial Institution 3		
_47	HSBC Bank plc	UBS		0.662	3.418
_48	HSBC Bank plc	Standard Chartered Bank	UBS	0.609	3.214
_49	Barclays Bank Plc	Santander UK Plc	UBS	0.638	3.495
_50	Sainsbury's Bank plc	Standard Chartered Bank		0.814	3.799
_51	Co-operative Bank Plc (The)	HSBC Bank plc	AIB	0.874	3.946
_52	Barclays Bank Plc	AIB		0.617	3.186
_53	HSBC Bank plc	Sainsbury's Bank plc	AIB	0.649	3.427
_54	Sainsbury's Bank plc	Standard Chartered Bank	AIB	0.826	3.849
_55	Co-operative Bank Plc (The)	Santander UK Plc	AIB	0.904	4.167
_56	HSBC Bank plc	UBS	AIB	0.719	3.674
_57	Barclays Bank Plc	Standard Chartered Bank	UBS	0.671	3.442
_58	Barclays Bank Plc	Co-operative Bank Plc (The)	Santander UK Plc	0.769	3.578
_59	Barclays Bank Plc	Sainsbury's Bank plc		0.691	3.642
_60	Santander UK Plc	UBS	AIB	0.784	3.714
_61	Barclays Bank Plc	Sainsbury's Bank plc	AIB	0.726	3.941
_62	Standard Chartered Bank	UBS	AIB	0.834	3.891

This table demonstrate those UK prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after a Financial shock, with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities.

Table 3.17.b: Greece: Half - Life & Total Effect after a Financial shock

		Half Life (years)	Total Effect (abs. values %)
	Banking system *Before* recent consolidation activity without any M&A	1.557	15.048
	Banking system *Before* recent consolidation activity with Potential M&A		
_1	ETHNIKI-AEGEAN	0.738	10.314
_2	ETHNIKI-PANCREATAN	0.791	11.183
_3	ETHNIKI-FFB-PROBANK	0.677	9.912
_4	ETHNIKI-PROBANK	0.804	11.008
_5	ETHNIKI-PANELLINIA	1.041	12.261
_6	ETHNIKI-ATTICA	1.199	13.184
_7	ETHNIKI-FFB-PROBANK-AEGEAN	0.548	9.194
_8	ALPHA-EMPORIKI-AEGEAN-PANCRETAN	0.816	12.443
_9	ETHNIKI-FBB	1.048	11.544
_10	ALPHA-EMPORIKI-AEGEAN	0.867	10.992
_11	ALPHA-EMPORIKI-PANCRETAN	0.924	11.472
_12	ETHNIKI-FFB-PROBANK-PANCRETAN	0.716	9.918
_13	PIRAEUS-AEGEAN	1.118	13.675
_14	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	0.847	11.911
_15	ALPHA-EMPORIKI-AEGEAN-PANELLINIA	1.082	13.316
_16	ALPHA-ATTICA	1.244	12.554
_17	EUROBANK_TT_HELLENIC	1.033	13.461
_18	ALPHA-PANCREATAN	1.041	11.986
_19	EUROBANK-AEGEAN	1.004	12.781
_20	ALPHA-AEGEAN	0.976	11.502
_21	PIRAEUS-MARFIN_EGNATIA	1.191	14.372
_22	ALPHA-EMPORIKI	1.073	13.411
_23	PIRAEUS-MARFIN_EGANTIA-MILLENIUM	1.124	14.554
_24	ETHNIKI-FFB-PROBANK-PANELLINIA-PANCRETAN	1.079	12.542
_25	EUROBANK-PROTON_TT-HELLENIC-AEGEAN	1.335	14.848
_26	EUROBANK-PROTON_TT-HELLENIC-PANCRETAN	1.408	14.894
	Banking system *After* recent consolidation activity without any M&A	1.166	12.573
	Banking system *After* recent consolidation activity with Potential M&A		
_1	ETHNIKI-FFB-PROBANK	0.177	7.412
_2	ETHNIKI-FFB-PROBANK-AEGEAN	0.048	6.694
_3	ALPHA-EMPORIKI-AEGEAN-PANCRETAN	0.316	9.943
_4	ALPHA-EMPORIKI-AEGEAN	0.367	8.492
_5	ALPHA-EMPORIKI-PANCRETAN	0.424	8.972
_6	ETHNIKI-FFB-PROBANK-PANCRETAN	0.216	7.418
_7	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	0.347	9.411
_8	ALPHA-EMPORIKI-AEGEAN-PANELLINIA	0.582	10.816
_9	ALPHA-EMPORIKI	0.573	10.911
_10	ETHNIKI-FFB-PROBANK-PANELLINIA-PANCRETAN	0.579	10.042
_11	EUROBANK-PROTON_TT-HELLENIC-AEGEAN	0.835	12.348
_12	EUROBANK-PROTON_TT-HELLENIC-PANCRETAN	0.908	12.394

This table demonstrate those Greek prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after a Financial shock, with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities. Results are reported for both states of the Greek banking sector, i.e. with and without accounting for the recent wave of M&As.

Table 3.18.a: UK: Half - Life & Total Effect after a Bank shock

				Half Life (years)	Total Effect (abs. values %)
		Banking System without any M&A		0.767	3.149
		Banking System with Potential M&A			
	Financial Institution 1	Financial Institution 2	Financial Institution 3		
_1	HSBC Bank plc	Lloyds TSB Bank Plc		0.624	2.478
_2	HSBC Bank plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	0.579	2.317
_3	Barclays Bank Plc	HSBC Bank plc	Lloyds TSB Bank Plc	0.472	1.884
_4	Barclays Bank Plc	HSBC Bank plc	Royal Bank of Scotland Plc (The)	0.503	2.076
_5	HSBC Bank plc	Royal Bank of Scotland Plc (The)		0.514	2.142
_6	HSBC Bank plc	Lloyds TSB Bank Plc	Santander UK Plc	0.516	1.847
_7	Barclays Bank Plc	Lloyds TSB Bank Plc		0.614	3.047
_8	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	0.497	1.945
_9	HSBC Bank plc	Lloyds TSB Bank Plc	Standard Chartered Bank	0.476	1.716
_10	Barclays Bank Plc	Lloyds TSB Bank Plc	Santander UK Plc	0.594	2.814
_11	Lloyds TSB Bank Plc	Santander UK Plc		0.622	3.016
_12	Royal Bank of Scotland Plc (The)	Santander UK Plc	Standard Chartered Bank	0.546	2.689
_13	HSBC Bank plc	Lloyds TSB Bank Plc	AIB	0.615	2.717
_14	Barclays Bank Plc	Lloyds TSB Bank Plc	Standard Chartered Bank	0.561	3.047
_15	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	0.494	3.086
_16	Barclays Bank Plc	HSBC Bank plc		0.513	2.063
_17	HSBC Bank plc	Santander UK Plc	Standard Chartered Bank	0.415	1.289
_18	Barclays Bank Plc	Lloyds TSB Bank Plc	Sainsbury's Bank plc	0.698	3.084
_19	Barclays Bank Plc	HSBC Bank plc	Santander UK Plc	0.423	1.374
_20	Barclays Bank Plc	HSBC Bank plc	AIB	0.493	1.746
_21	Barclays Bank Plc	HSBC Bank plc	Sainsbury's Bank plc	0.594	2.073
_22	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	0.647	2.431
_23	HSBC Bank plc	Royal Bank of Scotland Plc (The)	AIB	0.604	2.634
_24	Barclays Bank Plc	Santander UK Plc	Standard Chartered Bank	0.464	1.714
_25	Barclays Bank Plc	Royal Bank of Scotland Plc (The)		0.671	2.613
_26	Lloyds TSB Bank Plc	Standard Chartered Bank	AIB	0.713	3.104
_27	Barclays Bank Plc	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	0.667	3.006
_28	HSBC Bank plc	Santander UK Plc		0.472	1.63
_29	Lloyds TSB Bank Plc	AIB		0.704	3.067
_30	HSBC Bank plc	Sainsbury's Bank plc	Santander UK Plc	0.614	2.014
_31	Royal Bank of Scotland Plc (The)	Standard Chartered Bank	AIB	0.711	2.913
_32	Royal Bank of Scotland Plc (The)	Sainsbury's Bank plc	Santander UK Plc	0.728	2.987
_33	HSBC Bank plc	Standard Chartered Bank		0.487	1.671
_34	Barclays Bank Plc	HSBC Bank plc	Standard Chartered Bank	0.427	1.344
_35	Barclays Bank Plc	Sainsbury's Bank plc	Santander UK Plc	0.594	2.437
_36	Santander UK Plc	Standard Chartered Bank		0.514	1.749
_37	HSBC Bank plc	Santander UK Plc	AIB	0.473	1.943
_38	HSBC Bank plc	Sainsbury's Bank plc	Standard Chartered Bank	0.514	2.476
_39	Santander UK Plc	Standard Chartered Bank	AIB	0.576	2.871
_40	Barclays Bank Plc	HSBC Bank plc	UBS	0.514	2.656
_41	Co-operative Bank Plc (The)	Santander UK Plc	Standard Chartered Bank	0.668	2.839
_42	Barclays Bank Plc	Sainsbury's Bank plc	Standard Chartered Bank	0.694	3.084
_43	Barclays Bank Plc	Standard Chartered Bank	AIB	0.589	2.461
_44	Co-operative Bank Plc (The)	HSBC Bank plc	Santander UK Plc	0.544	2.694
_45	Barclays Bank Plc	Standard Chartered Bank		0.519	1.949
_46	Barclays Bank Plc	Santander UK Plc		0.504	1.884
_47	Santander UK Plc	AIB		0.579	2.341
_48	Sainsbury's Bank plc	Santander UK Plc	Standard Chartered Bank	0.536	2.093
_49	Santander UK Plc	Standard Chartered Bank	UBS	0.579	2.465
_50	HSBC Bank plc	Santander UK Plc	UBS	0.514	1.784

(Continued)

Table 3.18.a: UK: Half - Life & Total Effect after a Bank shock (Continued)

	Financial Institution 1	Financial Institution 2	Financial Institution 3	Half Life (years)	Total Effect (abs. values %)
		Banking System without any M&A		0.767	3.149
		Banking System with Potential M&A			
_51	HSBC Bank plc	Standard Chartered Bank	UBS	0.526	1.804
_52	Sainsbury's Bank plc	Santander UK Plc		0.657	2.942
_53	Barclays Bank Plc	Santander UK Plc	UBS	0.534	1.974
_54	Santander UK Plc	UBS		0.624	2.614
_55	Sainsbury's Bank plc	Standard Chartered Bank		0.688	2.946
_56	Sainsbury's Bank plc	Santander UK Plc	AIB	0.617	2.514
_57	Standard Chartered Bank	UBS		0.634	2.725
_58	Sainsbury's Bank plc	Santander UK Plc	UBS	0.727	3.041
_59	Sainsbury's Bank plc	Standard Chartered Bank	UBS	0.748	3.106
_60	Barclays Bank Plc	Standard Chartered Bank	UBS	0.499	1.874
_61	HSBC Bank plc	Sainsbury's Bank plc	UBS	0.608	2.493

This table demonstrate those UK prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after a Bank shock, with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities.

Table 3.18.b: Greece: Half - Life & Total Effect after a Bank shock

		Half Life (years)	Total Effect (abs. values %)
	Banking system *Before* recent consolidation activity without any M&A	0.902	13.165
	Banking system *Before* recent consolidation activity with Potential M&A		
_1	ETHNIKI-AEGEAN	0.574	8.687
_2	ETHNIKI-PANCREATAN	0.607	8.988
_3	ETHNIKI-FFB-PROBANK	0.512	7.841
_4	ETHNIKI-PROBANK	0.613	9.265
_5	ETHNIKI-PANELLINIA	0.817	10.173
_6	ETHNIKI-FFB-PROBANK-AEGEAN	0.468	8.191
_7	ETHNIKI-FBB	0.797	9.384
_8	ALPHA-EMPORIKI-AEGEAN	0.662	9.461
_9	ALPHA-EMPORIKI-PANCRETAN	0.704	9.965
_10	ETHNIKI-FFB-PROBANK-PANCRETAN	0.517	8.716
_11	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	0.684	9.684
_12	ALPHA-PANCREATAN	0.791	10.411
_13	ALPHA-AEGEAN	0.804	10.485
_14	ALPHA-EMPORIKI-PANELLINIA	0.871	10.766
_15	EUROBANK-PANCRETAN	0.716	10.081
_16	PIRAEUS-MARFIN_EGNATIA	0.791	10.541
_17	ALPHA-EMPORIKI	0.701	9.842
_18	ETHNIKI-FFB-PROBANK-AEGEAN-PANELLINIA	0.775	10.214
_19	PIRAEUS-MARFIN_EGANTIA-MILLENIUM	0.658	9.477
_20	ETHNIKI-FFB-PROBANK-PANELLINIA-PANCRETAN	0.808	10.763
_21	PIRAEUS-MILLENIUM	0.824	10.944
_22	EUROBANK-PROTON_TT-HELLENIC-AEGEAN-PANCRETAN	0.897	11.084
_23	AEGEAN-PANELLINIA-PANCRETAN	0.836	10.773
	Banking system *After* recent consolidation activity without any M&A	1.921	18.208
	Banking system *After* recent consolidation activity with Potential M&A		
_1	ETHNIKI-FFB-PROBANK	1.613	16.265
_2	ETHNIKI-FFB-PROBANK-AEGEAN	1.775	17.214
_3	ALPHA-EMPORIKI-AEGEAN	1.662	16.461
_4	ALPHA-EMPORIKI-PANCRETAN	1.704	16.965
_5	ETHNIKI-FFB-PROBANK-PANCRETAN	1.517	15.716
_6	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	1.684	16.684
_7	ALPHA-EMPORIKI-PANELLINIA	1.871	17.766
_8	ALPHA-EMPORIKI	1.701	16.842
_9	ETHNIKI-FFB-PROBANK-AEGEAN-PANELLINIA	1.808	17.763
_10	ETHNIKI-FFB-PROBANK-PANELLINIA-PANCRETAN	1.808	17.763
_11	EUROBANK-PROTON_TT-HELLENIC-AEGEAN-PANCRETAN	1.897	18.084
_12	AEGEAN-PANELLINIA-PANCRETAN	1.836	17.773

This table demonstrate those Greek prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after a Bank shock, with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities. Results are reported for both states of the Greek banking sector, i.e. with and without accounting for the recent wave of M&As.

Table 3.19.a: UK: Half - Life & Total Effect after all three shocks

				Macroeconomic Shock		Financial Shock		Bank Shock	
				Half Life (years)	Total Effect (abs. values %)	Half Life (years)	Total Effect (abs. values %)	Half Life (years)	Total Effect (abs. values %)
		Banking System without any M&A		1.651	8.531	0.963	4.234	0.767	3.149
		Banking System with Potential M&A							
	Financial Institution 1	Financial Institution 2	Financial Institution 3						
_1	HSBC Bank plc	Lloyds TSB Bank Plc	Royal Bank of Scotland Plc (The)	1.415	5.574	0.687	2.247	0.579	2.317
_2	Barclays Bank Plc	HSBC Bank plc	Lloyds TSB Bank Plc	1.274	4.348	0.574	2.695	0.472	1.884
_3	HSBC Bank plc	Royal Bank of Scotland Plc (The)		1.327	4.912	0.698	2.781	0.514	2.142
_4	HSBC Bank plc	Royal Bank of Scotland Plc (The)	Santander UK Plc	1.317	4.774	0.576	2.754	0.497	1.945
_5	Royal Bank of Scotland Plc (The)	Santander UK Plc	Standard Chartered Bank	1.482	7.156	0.679	3.014	0.546	2.689
_6	Barclays Bank Plc	HSBC Bank plc		1.289	4.782	0.579	2.524	0.513	2.063
_7	HSBC Bank plc	Santander UK Plc	Standard Chartered Bank	1.267	4.431	0.537	2.246	0.415	1.289
_8	Barclays Bank Plc	HSBC Bank plc	Santander UK Plc	1.243	4.317	0.528	2.197	0.423	1.374
_9	Barclays Bank Plc	Santander UK Plc	Standard Chartered Bank	1.273	4.371	0.581	2.576	0.464	1.714
_10	HSBC Bank plc	Santander UK Plc		1.297	4.782	0.591	2.768	0.472	1.63
_11	HSBC Bank plc	Standard Chartered Bank		1.301	5.379	0.608	2.943	0.487	1.671
_12	Barclays Bank Plc	HSBC Bank plc	Standard Chartered Bank	1.251	4.387	0.536	2.297	0.427	1.344
_13	Santander UK Plc	Standard Chartered Bank		1.342	5.038	0.624	3.072	0.514	1.749
_14	Barclays Bank Plc	Standard Chartered Bank		1.304	4.864	0.614	3.173	0.519	1.949
_15	Barclays Bank Plc	Santander UK Plc		1.287	4.643	0.597	3.067	0.504	1.884

This table demonstrate those UK prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after all three different types of shocks (i.e Macroeconomic, Financial, Bank) with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities.

Table 3.19.b: Greece: Half - Life & Total Effect after all three shocks

		Macroeconomic Shock		Financial Shock		Bank Shock	
		Half Life (years)	Total Effect (abs. values %)	Half Life (years)	Total Effect (abs. values %)	Half Life (years)	Total Effect (abs. values %)
	Banking system *Before* recent consolidation activity without any M&A	1.914	16.165	1.557	15.048	0.902	13.165
	Banking system *Before* recent consolidation activity with Potential M&A						
_1	ETHNIKI-AEGEAN	1.598	11.745	0.738	10.314	0.574	8.687
_2	ETHNIKI-PANCREATAN	1.645	12.186	0.791	11.183	0.607	8.988
_3	ETHNIKI-FFB-PROBANK	1.481	10.946	0.677	9.912	0.512	7.841
_4	ETHNIKI-PROBANK	1.694	12.357	0.804	11.008	0.613	9.265
_5	ETHNIKI-FFB-PROBANK-AEGEAN	1.254	9.864	0.548	9.194	0.468	8.191
_6	ETHNIKI-FBB	1.671	12.684	1.048	11.544	0.797	9.384
_7	ALPHA-EMPORIKI-AEGEAN	1.487	11.493	0.867	10.992	0.662	9.461
_8	ALPHA-EMPORIKI-PANCRETAN	1.569	11.717	0.924	11.472	0.704	9.965
_9	ETHNIKI-FFB-PROBANK-PANCRETAN	1.347	10.468	0.716	9.918	0.517	8.716
_10	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	1.378	11.064	0.847	11.911	0.684	9.684
_11	ALPHA-PANCREATAN	1.617	12.397	1.041	11.986	0.791	10.411
_12	ALPHA-AEGEAN	1.571	12.078	0.976	11.502	0.804	10.485
_13	ALPHA-EMPORIKI	1.643	12.755	1.073	13.411	0.701	9.842
	Banking system *After* recent consolidation activity without any M&A	2.682	21.597	1.166	12.573	1.921	18.208
	Banking system *After* recent consolidation activity with Potential M&A						
_1	ETHNIKI-FFB-PROBANK	2.316	14.699	0.177	7.412	1.613	16.265
_2	ETHNIKI-FFB-PROBANK-AEGEAN	2.186	13.937	0.048	6.694	1.775	17.214
_3	ALPHA-EMPORIKI-AEGEAN	2.379	15.522	0.367	8.492	1.662	16.461
_4	ALPHA-EMPORIKI-PANCRETAN	2.461	16.691	0.424	8.972	1.704	16.965
_5	ETHNIKI-FFB-PROBANK-PANCRETAN	2.287	14.462	0.216	7.418	1.517	15.716
_6	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	2.428	15.923	0.347	9.411	1.684	16.684
_7	ALPHA-EMPORIKI	2.583	18.461	0.573	10.911	1.701	16.842

This table demonstrate those Greek prospective combinations of banks' M&A which form a banking sector whose half-life and total effect after all three different types of shocks (i.e Macroeconomic, Financial, Bank) with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities. Results are reported for both states of the Greek banking sector, i.e. with and without accounting for the recent wave of M&As.

Table 3.20.a: UK: Half - Life & Total Effect after all three shocks - Simultaneous Hypothetical M&As scenarios

								Macroeconomic Shock		Financial Shock		Bank Shock	
								Half Life (years)	Total Effect (abs. values %)	Half Life (years)	Total Effect (abs. values %)	Half Life (years)	Total Effect (abs. values %)
	Banking System without any M&A							1.651	8.531	0.963	4.234	0.767	3.149
	Banking System with Potential M&A												
	Financial Institution 1	Financial Institution 2	Financial Institution 3		Financial Institution 1	Financial Institution 2	Financial Institution 3						
_1	HSBC	Lloyds	RBS	&	Barclays	Santander	Standard Chart.	1.317	4.934	0.617	2.376	0.507	1.976
_2	HSBC	Lloyds	RBS	&	Santander	Standard Chart.		1.352	5.211	0.636	2.513	0.522	1.981
_3	HSBC	Lloyds	RBS	&	Barclays	Standard Chart.		1.338	5.184	0.6437	2.571	0.528	2.094
_4	HSBC	Lloyds	RBS	&	Barclays	Santander		1.347	5.074	0.642	2.593	0.516	2.071
_5	Barclays	HSBC	Lloyds	&	RBS	Santander	Standard Chart.	1.364	5.618	0.6174	2.714	0.481	2.194
_6	Barclays	HSBC	Lloyds	&	Santander	Standard Chart.		1.291	4.524	0.583	2.694	0.473	1.714
_7	HSBC	RBS		&	Barclays	Santander	Standard Chart.	1.288	4.537	0.628	2.543	0.464	1.768
_8	HSBC	RBS		&	Santander	Standard Chart.		1.319	4.861	0.649	2.843	0.489	1.827
_9	HSBC	RBS		&	Barclays	Standard Chart.		1.309	4.721	0.643	2.846	0.506	1.716
_10	HSBC	RBS		&	Barclays	Santander		1.296	4.691	0.632	2.813	0.482	1.964
_11	HSBC	RBS	Santander	&	Barclays	Standard Chart.		1.301	4.709	0.576	2.794	0.467	1.834
_12	RBS	Santander	Standard Chart.	&	Barclays	HSBC		1.364	5.814	0.611	2.614	0.506	2.183
_13	Barclays	HSBC		&	Santander	Standard Chart.		1.306	4.763	0.584	2.583	0.488	1.766
_14	HSBC	Santander		&	Barclays	Standard Chart.		1.284	4.687	0.591	2.847	0.461	1.534
_15	HSBC	Standard Chart.		&	Barclays	Santander		1.267	4.904	0.526	2.846	0.478	1.627

This table demonstrate those UK prospective combinations of banks' M&A that can occur simultaneously and form a banking sector whose half-life and total effect after all three different types of shocks (i.e Macroeconomic, Financial, Bank) with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities.

Table 3.20.b: Greece: Half - Life & Total Effect after all three shocks - Simultaneous Hypothetical M&As scenarios

				Macroeconomic Sho		Financial Shock		Bank Shock	
				(years)	Effect	(years)	Effect	(years)	Effect
	Banking system *Before* recent consolidation activity without any M&A			1.914	16.165	1.557	15.048	0.902	13.165
	Banking system *Before* recent consolidation activity with Potential M&A								
	Financial Institution 1		Financial Institution 1						
_1	ETHNIKI-AEGEAN	&	ALPHA-EMPORIKI-PANCRETAN	1.481	11.406	0.661	10.703	0.469	9.136
_2	ETHNIKI-AEGEAN	&	ALPHA-PANCREATAN	1.586	11.715	0.719	10.9623	0.512	9.359
_3	ETHNIKI-AEGEAN	&	ALPHA-EMPORIKI	1.606	12.008	0.735	11.672	0.467	9.074
_4	ETHNIKI-PANCREATAN	&	ALPHA-EMPORIKI-AEGEAN	1.513	11.571	0.659	10.897	0.464	9.034
_5	ETHNIKI-PANCREATAN	&	ALPHA-AEGEAN	1.583	11.892	0.713	11.152	0.535	9.546
_6	ETHNIKI-PANCREATAN	&	ALPHA-EMPORIKI	1.584	12.173	0.762	12.107	0.484	9.225
_7	ETHNIKI-FFB-PROBANK	&	ALPHA-EMPORIKI-AEGEAN	1.388	10.943	0.602	10.262	0.417	8.461
_8	ETHNIKI-FFB-PROBANK	&	ALPHA-EMPORIKI-PANCRETAN	1.525	11.046	0.631	10.502	0.438	8.713
_9	ETHNIKI-FFB-PROBANK	&	ALPHA-PANCREATAN	1.516	11.284	0.689	10.759	0.481	8.936
_10	ETHNIKI-FFB-PROBANK	&	ALPHA-AEGEAN	1.495	11.287	0.656	10.517	0.488	8.973
_11	ETHNIKI-PROBANK	&	ALPHA-EMPORIKI	1.625	12.148	0.768	12.019	0.487	9.363
_12	ETHNIKI-PROBANK	&	ALPHA-EMPORIKI-AEGEAN	1.51	11.473	0.665	10.812	0.467	9.173
_13	ETHNIKI-PROBANK	&	ALPHA-EMPORIKI-PANCRETAN	1.591	11.849	0.694	11.053	0.488	9.425
_14	ETHNIKI-PROBANK	&	ALPHA-PANCREATAN	1.616	12.217	0.752	11.307	0.532	9.648
_15	ETHNIKI-PROBANK	&	ALPHA-AEGEAN	1.583	12.084	0.722	11.065	0.538	9.685
_16	ETHNIKI-PROBANK	&	ALPHA-EMPORIKI	1.604	12.451	0.768	12.019	0.487	9.363
_17	ETHNIKI-FFB-PROBANK-AEGEAN	&	ALPHA-EMPORIKI-PANCRETAN	1.391	10.482	0.566	10.143	0.416	8.888
_18	ETHNIKI-FFB-PROBANK-AEGEAN	&	ALPHA-PANCREATAN	1.404	11.007	0.624	10.403	0.459	9.111
_19	ETHNIKI-FFB-PROBANK-AEGEAN	&	ALPHA-EMPORIKI	1.417	11.158	0.643	11.112	0.414	8.826
_20	ETHNIKI-FBB	&	ALPHA-EMPORIKI-AEGEAN	1.553	11.904	0.787	11.078	0.559	9.232
_21	ETHNIKI-FBB	&	ALPHA-EMPORIKI-PANCRETAN	1.591	12.186	0.816	11.318	0.581	9.484
_22	ETHNIKI-FBB	&	ALPHA-PANCREATAN	1.611	12.511	0.874	11.575	0.624	9.707
_23	ETHNIKI-FBB	&	ALPHA-AEGEAN	1.608	12.246	0.842	11.333	0.632	9.744
_24	ETHNIKI-FBB	&	ALPHA-EMPORIKI	1.629	12.614	0.893	12.287	0.579	9.423
_25	ALPHA-EMPORIKI-AEGEAN	&	ETHNIKI-FFB-PROBANK-PANCRETAN	1.389	10.671	0.621	10.265	0.419	8.898
_26	ETHNIKI-FFB-PROBANK-PANCRETAN	&	ALPHA-AEGEAN	1.421	11.182	0.676	10.521	0.493	9.412
_27	ETHNIKI-FFB-PROBANK-PANCRETAN	&	ALPHA-EMPORIKI	1.461	11.591	0.724	11.474	0.439	9.089
	Banking system *After* recent consolidation activity without any M&A			2.682	21.597	1.166	12.573	1.921	18.208
	Banking system *After* recent consolidation activity with Potential M&A								
_1	ETHNIKI-FFB-PROBANK	&	ALPHA-EMPORIKI-AEGEAN	2.331	15.076	0.102	7.762	1.467	16.173
_2	ETHNIKI-FFB-PROBANK	&	ALPHA-EMPORIKI-PANCRETAN	2.361	15.493	0.131	8.002	1.488	16.425
_3	ETHNIKI-FFB-PROBANK	&	ALPHA-EMPORIKI	2.428	15.611	0.205	8.971	1.487	16.363
_4	ETHNIKI-FFB-PROBANK-AEGEAN	&	ALPHA-EMPORIKI-AEGEAN	2.262	14.683	0.037	7.403	1.548	16.647
_5	ETHNIKI-FFB-PROBANK-AEGEAN	&	ALPHA-EMPORIKI-PANCRETAN	2.307	15.148	0.066	7.643	1.569	16.899
_6	ETHNIKI-FFB-PROBANK-AEGEAN	&	ALPHA-EMPORIKI	2.369	15.871	0.141	8.612	1.568	16.838
_7	ALPHA-EMPORIKI-AEGEAN	&	ETHNIKI-FFB-PROBANK-PANCRETAN	2.314	14.764	0.123	7.765	1.419	15.898
_8	ALPHA-EMPORIKI-AEGEAN	&	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	2.374	15.617	0.187	8.761	1.503	16.382
_9	ETHNIKI-FFB-PROBANK-PANCRETAN	&	ALPHA-EMPORIKI	2.367	16.308	0.224	8.974	1.439	16.089
_10	ETHNIKI-FFB-PROBANK-AEGEAN-PANCRETAN	&	ALPHA-EMPORIKI	2.467	16.948	0.292	9.971	1.522	16.573

This table demonstrate those Greek prospective combinations of banks' M&A that can occur simultaneously and which form a banking sector whose half-life and total effect after all three different types of shocks (i.e Macroeconomic, Financial, Bank) with respect to its 'liquidity creation', is less than the respective ones which derive from a banking system without the presence of those specific potential banks' consolidation activities. Results are reported for both states of the Greek banking sector, i.e. with and without accounting for the recent wave of M&As.

Chapter 4

Assessing Bank Efficiency and Stability

4.1 Introduction

There is a vast literature aiming at testing efficiency of banks that goes under the title 'non-structural and structural approaches'. The non-structural approach compares productivity and performance ratios among banks and considers how these ratios are related to investment strategies and banks' characteristics, such as the quality of banks' governance, its product mix, etc. The structural approach usually relies on the economics of cost minimization or profit maximization, where the performance equation denotes a cost function or a profit function. In the most recent literature, the optimization problem is managerial utility maximization, where the manager trades off risk and expected return.

As far as the structural performance equation is concerned, this can be fitted into the data as an average relationship, which assumes that all banks are equally efficient at minimizing cost or maximizing profit, subject to random error ε_i, which is assumed to be normally distributed. Alternatively, the structural performance equation can be estimated as a stochastic frontier to capture best-practice and to gauge inefficiency; i.e., the difference between the best-practice performance and achieved performance.

In the stochastic frontier, the error term, ε_i, consists of two components; a two-sided random error that represents noise (v_i) and a one-sided (i.e. nonnegative) error representing inefficiency (u_i). Banks' inefficiency is usually estimated by the mean of the conditional distribution of u_i given ε_i i.e., $E(u_i|\varepsilon_i)$. The difference between best-practice and achieved performance gauges managerial inefficiency in terms of either excessive cost – cost inefficiency – or lost profit – profit inefficiency.

The standard profit function studied in the literature (Berger and Mester, 1997), in log form, is:

$$\ln(\pi_i + \theta) = f(p_i, w_i) + \ln v_i - \ln u_i, \tag{4.1.1}$$

where π_i denotes profits of firm i; θ is a constant added to the profits of each bank in order to attain positive values, enabling them to be treated logarithmically; p_i is the vector of prices of variable inputs; w_i is the vector of prices of the variable outputs.

Profit efficiency is the ratio of the predicted actual profits to the predicted maximum profits that could be earned if the bank was as efficient as the best-practice bank in the sample, net of random error, or the proportion of maximum profits that are actually earned and is represented by the following equation:

$$Std\ \pi EFF_i = \frac{\pi_i}{\pi_{\max}} = \frac{\{\exp\left[f(p_i, w_i)\right] * \exp\left[u_{\pi i}\right]\} - \theta}{\{\exp\left[f(p_{\max}, w_{\max})\right] * \exp\left[u_{\pi \max}\right]\} - \theta}, \tag{4.1.2}$$

where $u_{\pi \max}$ represents the maximum value of $u_{\pi i}$ in the sample.

Standard profit efficiency measures determine how close a bank is to producing the maximum possible profit given a particular level of input prices and output prices (and other variables). In contrast to the cost function, the standard profit function specifies variable profits in place of variable costs and takes variable output prices as given, rather than holding all output quantities statistically fixed at their observed, possibly inefficient, levels. That is, the profit dependent variable allows for consideration of revenues that can be earned by varying outputs as well as inputs. Output prices are taken as exogenous, allowing for inefficiencies in the choice of outputs when responding to these prices or to any other arguments of the profit function. In our opinion, the profit efficiency concept is superior to the cost efficiency concept for evaluating the overall performance of the firm. Profit efficiency accounts for errors on the output side as well as those on the input side, and some prior evidence suggests that inefficiencies on the output side may be as large or larger than those on the input side (e.g., Berger et al. 1993). Profit efficiency is based on the more accepted economic goal of profit maximization, which requires that the same amount of managerial attention be paid to raising a marginal dollar of revenue as well as to reducing a marginal dollar of costs. That is, a firm that spends one additional dollar to raise revenues by $2, all else being equal, would appropriately be measured as being more profit efficient but might inappropriately be measured as being less cost efficient. Profit efficiency is based on a comparison with the best-practice point of profit maximization within the data set, whereas cost efficiency evaluates performance holding output constant at its current level, which generally will not correspond to an optimum. A firm that is relatively cost efficient at its current output may or may not be cost efficient at its optimal output, which typically involves a different scale and mix of outputs. Thus, standard profit efficiency may take better account of cost inefficiency than the cost efficiency measure itself, since standard profit efficiency embodies the cost inefficiency deviations from the optimal point.

The standard profit function assumes that markets for outputs and inputs are perfectly competitive. The exogenous nature of prices in this concept of profit efficiency assumes that there is no market power on the banks' side. If, instead of taking prices as given, it is assumed the possibility of imperfect competition, it would be taken as given only the output vector, and not that of prices. Thus, Berger and Mester (1997) define the alternative profit function where banks take as given the quantity of output (y) and the price of inputs (p) and maximise profits by adjusting the price of the output (w) and the quantity of inputs:

$$\ln(\pi_i + \theta) = f(p_i, q_i) + \ln v_i - \ln u_i \tag{4.1.3}$$

As with standard profit efficiency, alternative profit efficiency is the ratio of predicted actual profits to the predicted maximum profits for a best-practice bank:

$$Alt\pi EFF_i = \frac{a\pi_i}{a\pi_{\max}} = \frac{\{\exp[f(p_i, q_i)] * \exp[u_{\pi i}]\} - \theta}{\{\exp[f(p_{\max}, q_{\max})] * \exp[u_{\pi \max}]\} - \theta}, \tag{4.1.4}$$

The alternative profit function provides a way of controlling for unmeasured differences in output quality since it considers the additional revenue that higher quality output can generate.

Typically in the literature up to the late 90's, the cost and profit functions or frontiers are measured without considering the banks' capital structure or banks' choice of risk. As it noted by Hughes et al. (1996, 1999, 2000) this is a serious omission since banks' production technologies embody their ability to diversify and offset a variety of risks, and the production decisions that managers take may mirror their incentives to take on risks as well as to diversify them. Later in the literature (Hughes et al. (1996); Mester and Moon (2001)) are developed tests of inefficiency that include measures of risk which is reflected by equity capital (k). These authors estimate a best-practice risk-return frontier and measure inefficiency relative to it. Precisely, they suggest an estimation of a stochastic frontier similar to (4.1.1) that gives the highest expected return at any particular risk exposure:

$$E(\pi_i/k_i) = a_0 + a_i\sigma_i + a_2\sigma_i^2 + v_i - u_i, \tag{4.1.5}$$

where, they indicate that a bank's return inefficiency is the difference between its potential return and its noise-adjusted expected return, gauged among its peers with the same level of return risk. However, they don't consider whether banks' managers are taking too much or too little risk relative to the value-maximizing amount.

Among other things, this implies that current models and tests of banking efficiency are not able to take into account the trade-off that might exist between banks' efficiency and stability. The intution behind this is that equation (4.1.5) represents an *ex ante* indicator of risk. In other words a bank is equally efficient regardless of its position along the expected profit-risk efficient curve. We believe that for stability it is not irrelevant where the banks stands along this efficiency curve.

Indeed, modern banking theory emphasizes managers' contrasting incentives for risk-taking. On the one hand, increased risk taking may exploit valuable investment opportunities, while, on the other hand, reduced risk-taking protects a bank from costly episodes of financial distress involving liquidity crises, regulatory intervention, and even forfeiture of the banks' valuable charter. However, failure to take into account this important trade-off between efficiency and stability may reduce the predictive power of any efficiency model of banking and may bring about misleading conclusions on the welfare implications of banking structure and behaviour. As an example of this, a bank with too little expected profit for the amount of risk it is taking on is deemed inefficient. The aim of this paper is to shed light on the trade-off that banks' managers very often face between loosing profit opportunities today to increase their opportunities tomorrow. This trade-off comes from the fact that banks which take on too much risk relatively to their resources face a higher probability to be insolvent when adverse effects occur in the future.In other words, our assumption is that the level of a bank's risk depends not only on the degree of risk aversion of the manager (i.e. which point of the risk-return curve the managers chooses) but also on the objective circumstances which affect risk, as well as how much the bank is vulnerable to changes in the market conditions.

This study contributes in the literature of banking efficiency in two ways: Firstly, by presenting a new indicator of profit efficiency which takes into account both the propensity to risk (ex ante measure of risk) reflected by the vulnerability of the bank to changes to the financial markets conditions and the realized risk (ex post measure of risk) due to mismanagement of the bank. Secondly, by testing how efficient both current tests of banking efficiency as well as the one proposed in this paper are, with respect to the effect of the crisis on the probability to fail. The on-going financial and economic crisis provides a natural experiment to pursue this analysis. We would expect that more efficient banks at the onset of the crisis, other things being equal, to be able to withstand in a better the impact of the crisis. So, if this is true, the relative position of the banks from an efficiency point of view should be similar after and at the onset of the crisis. On the contrary, if the most efficient banks change their relative position during the crisis, it implies that current tests of efficiency have little predictive power, because they do not take into account other factors which may affect banks' risk and returns.

The first empirical strategy of the paper is to compare the deviation of banking efficiency estimates of the conventional index and our proposed risk - adjusted index at the onset and in the period during and after the recent financial crisis. With this in mind, we estimate efficiency of US commercial banks in three couples of sub-periods 2003-2004 and 2005-2006; 2005 -2006 and 2008 - 2009; and 2004-2006 and 2010-2012 in order to compare the relative position of the banks and draw conclusions on the capability of these tests to take account of changes in risk of financial institutions with respect to future bank profits. With this in mind we construct three different in range; i.e., deciles, quartiles, half-tiles, Markov transitions matrices accompanied by their respective probabilities and standard error matrices. The second empirical strategy of this study is to compare the explanatory and predictive power of each one of the two profit efficiency measures with respect to the growth of banks' profits. Thus, we investigate which index could signal in a more accurate way the severe erosion of profits that was about to occur during and after the global financial turmoil. The last empirical strategy of the paper is to compare in the same spirit as before the explanatory and predictive power of each test with respect to the profits on one hand of the financial institutions that remained solvent in the aftermath of the crisis and on the other hand of those that did not manage to withstand the severe adverse economic conditions both during and after the crisis.

We provide strong empirical evidence that our suggested profit efficiency index produces less deviation of its estimates compared to the standard in the literature index among all three different time periods (i.e., 'pre - crisis', 'during - crisis', 'post - crisis') and in all three different Markov transition matrices. This finding is being strengthened when we investigate the most extremes scenarios of changes of the relative position of banks;i.e, from the top 50% to the lowest (and vice-versa) 10%, 25% and 50% as far as deciles, quartiles and half-tiles are concerned respectively, as far each measure's profit efficiency estimates are concerned. In addition, our empirical results highlight the superiority of the risk - adjusted profit efficiency index regarding both its explanatory and predictive power throughout all groups of sub - samples chosen for comparison. The inadequateness of the standard profit efficiency measure is revealed once again when we differentiate our sample between 'saved' and 'failed' banks, since a dynamic 'risk - adjusted' index, such as the one we suggest, is found to capture with a higher degree of precision current and future bank - profits. Last but not least, we present indicative empirical evidence which highlights the statistical significance of our index in contrast to the characteristic insignificance of the standard profit efficiency index when they are jointly taken into account. In addition, we show that in various cases where both indexes coexist in the same model, the variable of banks' estimates deriving from the conventional profit efficiency measure contradicts with fundamental assumptions that underlie the theory of profit efficiency.

The rest of the paper is organized as follows. Section 4.2 explains the theoretical framework between bank efficiency and stability and specifies the model. Section 4.3 discusses our empirical methodology while section 4.4 describes the data. Section 4.5 presents the empirical evidence and robustness tests as well, while the final section concludes.

4.2 Theoretical Framework: Bank efficiency and stability

4.2.1 How efficient are bank efficiency tests?

On a theoretical ground, we would expect that efficient banks would fulfill two conditions; to produce the amount of output which maximizes profits or minimizes costs (economic efficiency) and to mix output and inputs to obtain the maximum profit or minimum cost at the lowest possible risk. In other words, to combine the portfolio in such a way that they can reach a point on the efficient frontier.

However, we pointed out above that efficiency and stability may not be complementary but substitutes. Higher productivity today may be achieved by undertaking excessive risks, and this may weaken the stability of the bank. With this in mind, we argue that current measures of efficiency do not take into account this trade-off.

Traditionally, a bank has been defined in terms of its twin functions, i.e. providing credit and offering demand deposits, or more generally, payment services. In addition to macroeconomic risks, bank loans to a large corporate client have a number of embedded risks such as the risk that interest rates will rise reducing the present value of future repayments or the risk that the client firm will default. However, loans provide more predictable expected revenues than non-interest income, such as fees, commissions and trading income. Thus, the latter are more closely related to the conditions in the capital and financial markets, and therefore are subject to more rapid changes than interest income.

Similarly, retail or core deposits tend to differ from other forms of bank funding because they are primarily held for their liquidity services and, in addition, are covered by deposit insurance. So, deposit funding tends to carry lower risks than non-deposit funding in causing a potential liquidity crisis. In addition, deposit and non-deposit funding are different in terms of the speed and size of changes in funding costs. Specifically, the volume and price of wholesale funding, can adjust more quickly to reflect bank's riskiness, and in some cases to reflect only the investors' sentiments.

Nevertheless, in the last decade there has been an unprecedented expansion of non-lending and non-deposit activities on banks' balance sheets fuelled very often by leverage.

Indeed, Demirguc–Kunt and Huizinga (2010) document that, as a result of the changing nature of the banks, in the period 1999-2007 the fee income share increased from 33% to 38% of total operating income. The overall trend in the non-deposit funding share has been downward over the same period, but this result is due to the decreasing trend of the commercial banks not of the other banks: reliance on non-deposit funding by investment banks and other banks has increased significantly until 2007.

This is due to the fact that, banks rationally pursue profits in booms, and accept book losses in busts, as money making opportunities in booms are so attractive. In busts, banks hold on to securities because of expected capital gains, rather than liquidate them and make fresh loans to new projects. But if banks borrow short term to underwrite securities that finance long term projects, they might not be able to maintain those investments on their books should economic conditons do not improve. Banks wish to hold on to these undervalued securities, but they are forced to liquidate by creditors. Leverage promotes a further expansion of balance sheets in boom times, and generally increases the cyclicality of investment and profits. In addition, leverage leads to liquidations of bank portfolios at prices below fundamental values in bad times.

Another source of the boom lending and risk in the last decade is due to securitization. Relative to direct lending, securitization raises the level of investment, but also cyclicality of profits and the balance sheet. In addition, it transmits fluctuations in investor sentiment into commercial banking and the real economy (Shleifer and Vishny, 2009).

Moreover, Rajan (2005) pointed out another channel of increasing risk in banking activity due to securitization. Risk transfer from the banks to the markets by securitization increases also the average risk of the loans, due to the fact that banks expand lending by financing lower quality projects.

So, there are countervailing effects of an increasing share of non-deposit funding and non-lending activities in the balance sheet. On one hand, banks can grow faster; on the other hand, it makes banking strategies that rely predominantly on generating noninterest income or attracting nondeposit funding very risky. As a matter of fact, the empirical evidence supports the view that banks that rely on fee-generating activities to a greater extent are subject to greater risk (Demirguc–Kunt and Huizinga, 2010). Moreover, in a recent paper Beltratti and Stulz (2012) show that more leveraged banks at the outset of the crisis performed worst during the crisis, which strengthens our belief that bank efficiency tests should account for leverage.

With this in mind, we suggest a new profit efficiency index which accounts for both an *ex post* and *ex ante* indicator of risk. Specifically, we introduce two different types of risks: the first (σ_1) is credit risk which is captured by the ratio of each bank's Non-Performing Loans($NPLs$) to its total loans(TLs) and represents and *ex post* risk indicator; the second (σ_2) is the risk deriving from excessive leverage and reflects an *ex ante* risk indicator as it captures to what extend the bank is vulnerable to adverse economic conditions. It is measured by the ratio of each bank's total assets to its overall level of equity capital (i.e. the sum of common equity, non-controlling interest, securities revaluation reserves and other accumulated comprehensive income). The proposed profit efficient indicator is expressed in the following way:

$$\ln(\pi_i/\sigma_i) = f(p_i, q_i) + \ln\sigma_{1i} + \ln\sigma_{2i} + \ln v_i - \ln u_i \qquad (4.2.1)$$

4.2.2 Model Specification

A critical discussion of the two mostly used approaches for measuring and defining inputs and outputs has been done by Berger and Humphrey (1997). They conclude that despite the fact that none of them is ideal, the production approach is preferable when we want to evaluate the efficiency of branches of financial institutions, whereas the intermediation approach is preferable when we want to analyse the efficiency of the whole financial institution. Therefore, in line with the vast and established literature regarding the determinants of cost efficiency in banking (Berger 2007), we specify the cost kernel components that represent the intermediation approach of banks used by Sealey and Lindley (1977) to define inputs and output[1]. In the present study we specify the two mainstream types of outputs as total loans (q_1) and total earning assets (q_2). Additionally, we specify as our three types of inputs: (1) the total intermediated funds (F), which consists of savings accounts, current accounts, time deposits, repurchase agreements and alternative funding sources, (2) the labor (L), which refers to the

[1] The key difference between the two approaches, is that production approach treats deposits as outputs, whereas intermediation approach treats them as inputs.

manpower involved in the operations of the all the credit institutions in the sample and (3) the physical capital depreciation and amortization (K), which consists of fixed assets, including tangible fixed assets (land, buildings, office equipment, etc., less depreciation) and intangible assets (software, underwriting expenses, research expenses, etc.). We measure the price of input (p_1) by using the ratio of interest expenses to total deposits and short term funding. Also we measure the price of input (p_2) by using the ratio of staff expenses to total assets. Lastly we measure the price of input (p_3) by using the ratio of fee and commission expenses added to administration expenses to fixed assets. As dependent variable we use total profits before tax (PBT).

At this point it is of crucial importance to discuss the problem of the possible negative values of the dependent variable. Theoretically our model assumes that $PBT \in R$, nevertheless, $\ln PBT$ is not defined if $PBT \in R_{-}$, where PBT $[-\infty, 0]$. In order to tackle the issue of negative profits (losses) we follow the approach proposed by Bos and Koetter (2011) that allows to use all of the available information in the sample. Specifically, we left-censor PBT, but assign a value of one to those banks with $PBT_{it} \in R_{-}$. In order to include all information available on the censored part of PBT and to this end specify an additional independent variable NPI (for Negative Profit Indicator). Consequently, we define NPI to be equal to one for observations where $PBT \in R^{+}$ and equal to the absolute value of PBT for a loss incurring bank.

The final specification of our profit stochastic frontier model takes the following log-linear form which represents a logarithmic transformation of a Cobb-Douglas production function:

$$\ln(PBT_{it}/(\sigma_{it})) = a_0 + \sum_{l=1}^{2} a_{ql} \ln q_{it,l} + \sum_{s=1}^{2} a_{ps} \ln p_{it,s} + a_{NPI} \ln NPI_{it} + a_{\sigma 1} \ln(\sigma 1_{it} + 1) + a_{\sigma 2} \ln(\sigma 2_{it}) + u_{it} - v_{it} \quad (4.2.2)$$

[2]. We note that linear homogeneity in input prices, has to be imposed a priori for the estimation of the profit frontier to develop approprietely. This requires:

$$\sum_{s=1}^{3} a_{ps} = 1 \quad (4.2.3)$$

In turn, linear homogeneity restrictions are imposed on all input prices and the dependent variable with respect to one of the input prices. Here we use the price of physical capital depreciation and amortization (p_3) as a numeraire.

4.3 Empirical Methodology

4.3.1 Transition of Banks

First, we compare the standard profit efficiency index with our suggested risk - adjusted index in terms of the robustness of the bank-specific profit efficiency scores they produce within different time periods. To pursue this analysis for each of the two profit efficiency indexes, we create three different in terms of range Markov transition matrices[3],

[2] 1 is a constant added to the ratio of each bank's Non-Performing Loans($NPLs$) to total loans(TLs) in order to enable it to be treated logarithmically.

[3] A Markov transition matrix derives from a Markov chain which is a mathematical system that undergoes transitions from one state to another on a state space.

i.e., deciles, quartiles and 'half-tiles'[4] and allocate each bank within each category according to its profit efficiency score. Thus, the least profit efficient banks are classified in the lowest half-tiles, quartiles, and deciles whereas the most efficient banks in the sample are allocated in the top of each respective range. With this in mind, we investigate the scale of deviation of the aforementioned ordering of banks with respect to each index among different time horizons. Consequently, we account for three different states of the economy; 'pre - crisis', 'during - crisis', 'post - crisis'. As far as the first one is concerned, we examine the deviation of banks' efficiency scores between 2003-2004 and 2005-2006, in order to test the robustness of each profit index in tranquil periods. The reasoning behind this, is to test the whether the performance of the two profit efficiency indicators is different when the impact of the financial turmoil is not taken into account. In the same spirit, we are interested in capturing potential changes that may have occurred during the recent financial turmoil and to investigate which index is able to account for these changes more accurately. Hence, we compare each index's profit efficiency estimates between 2005 -2006 and 2008 - 2009. Similarly, in the last couple of time periods that we select, we compare the profit efficiency scores of each index with respect to both normal times (i.e, 2004-2006) and the aftermath of the financial crisis (i.e., 2010-2012).

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[4] For the sake of euphony 'half-tile' refers to a two by two Markov transition matrix.

4.3.2 Explanatory & Predictive power

In the second step of our empirical strategy we address two issues: Firstly, we examine which one of the two profit efficiency indexes explains better the profits (PBT) of banks in three different 'pre - crisis' time periods; i.e., 2003-2004, 2005-2006 and 2004-2006. Thus, the following regression equations are estimated:

$$\ln PBT_{it} = a_0+a_1 \ln p_{1,it}+a_2 \ln p_{2,it}+a3 \ln q_{1,it}+a_4 \ln q_{2,it}+a_5 \ln NPI_{it}+a_6 PE_{it}+\varepsilon_{it} \tag{4.3.1}$$

$$\begin{aligned} \ln PBT_{it} &= a_0 + a_1 \ln p_{1,it} + a_2 \ln p_{2,it} + a_3 \ln q_{1,it} + a_4 \ln q_{2,it} + a_5 \ln NPI_{it} \\ &\quad +a_6 \sigma_{1,it} + a_7 \sigma_{2,it} + a_8 RiskadjPE_{it} + \varepsilon_{it}, \end{aligned} \tag{4.3.2}$$

where PE and $RiskadjPE$ reflect the estimated level of profit efficiency with respect to the conventional and the risk adjusted profit efficiency index and σ_1 and σ_2 refer to the *ex post* (i.e. credit risk) and to the *ex ante* (i.e excessive leverage) indicator of risk.

Secondly, we compare the two indexes in terms of their forecasting power. To be more precise by using the three aforementioned time periods we investigate which profit efficiency index can capture better the growth of bank profits in a 'pre - crisis', 'during - crisis' and 'post - crisis' state of the economy respectively. In a similar manner as in the first step we employ the same the regression equations but with the rudimentary difference that the dependent variable's value is calculated at future point in time:

$$\ln PBT_{i,t+n} = a_0+a_1 \ln p_{1,it}+a_2 \ln p_{2,it}+a3 \ln q_{1,it}+a_4 \ln q_{2,it}+a_5 \ln NPI_{it}+a_6 PE_{it}+\varepsilon_{it} \tag{4.3.3}$$

$$\begin{aligned}\ln PBT_{i,t+n} &= a_0 + a_1 \ln p_{1,it} + a_2 \ln p_{2,it} + a_3 \ln q_{1,it} + a_4 \ln q_{2,it} + a_5 \ln NPI_{it} \\ &+ a_6\sigma_{1,it} + a_7\sigma_{2,it} + a_8 RiskadjPE_{it} + \varepsilon_{it} \qquad (4.3.4)\end{aligned}$$

In this way, we investigate which index could be more adequately in line with the forthcoming distortion of the world's financial stability and the tremendous impact it had on the efficiency of various banking systems in both developed and emerging markets. In both the issues that we address (i.e. explanatory and predictive power of each index) we allow for a simultaneous examination of the two profit efficiency indexes in order to capture any unobserved dynamics among them which is represented by the following regression equation:

$$\begin{aligned}\ln PBT_{it\ \&\ i,t+n} &= a_0 + a_1 \ln p_{1,it} + a_2 \ln p_{2,it} + a_3 \ln q_{1,it} + a_4 \ln q_{2,it} + a_5 \ln NPI_{it} \\ &+ a_6\sigma_{1,it} + a_7\sigma_{2,it} + a_8 PE_{it} + a_9 RiskadjPE_{it} + \varepsilon_{it} \qquad (4.3.5)\end{aligned}$$

4.3.3 Conditional Specification

In the final step of our empirical methodology, we perform the same analysis we did in the previous step, but with a neuralgic difference: we differentiate our sample between banks that went bankrupt in the period 2008-2009 and in those that managed to survive the first impact of the financial turmoil. Additionally, to be able to capture any remaining adverse contagion effects, we account for the banks that became insolvent in the post crisis years (i.e., 2010-2011) and those who sustained their viability in the aftermath of the crisis. In this way, we examine which profit efficiency measure can explain better the development of banks' profits in both categories (i.e., 'saved' and 'failed' banks) not just for the comparison of the 'pre - crisis' with respect to the 'during -

crisis' period (i.e.,2005-2006 vs. 2008-2009), but for the comparison of the 'during - crisis' with respect to the 'post - crisis' period as well (i.e., 2008-2009 vs. 2010-2011). As before, we allow for the co-existence of the two profit efficiency benchmarks in every state of the economy.

4.4 Data

For the estimation of the model we use data that consists of an unbalanced panel[5] of all the commercial banks during the period 2003 - 2012 in the United States. Following the majority of empirical studies in banking, we obtain the largest part of our bank-level data from the Bankscope database of Bureau Van Dijk's company. Any missing information on the variables of interest is filled in from the official websites of the US banks and by the annual reports of the Board of Governors of the Federal Reserve System. Overall, our sample accounts for a significant market share in terms of assets, loans and deposits. More precisely, the sample consists of 75,219 observations for 8,886 financial institutions.

At this point we highlight a number of crucial points that we take into account in our data selection strategy. This strategy is of major importance in terms of accuracy of the results and of the inferences based on them. Regrettably it has been mistakenly disdained by the bulk of the empirical studies that have used Bankscope database (see Claessens and van Horen, 2012 and Clerides et. al 2013). To be more precise, first, we check both samples for double-counting observations.

[5] We note that as far as the first two empirical strategies; i.e., 'Transition of Banks' and 'Forecasting' are concerned we use a strongly balanced panel in order to make accurate comparisons of the two profit efficiency indexes in all three different states of the economy.

Bankscope provides company account statements for banks and financial institutions across the world by collecting financial statements with both consolidation and unconsolidation status. We select the unconsolidated data[6] and exclude the equivalent consolidated data to avoid double counting the same financial institution.

As a second step, we take into consideration mergers and acquisitions (M&A). For this purpose we thoroughly went through all M&A activities that took place in the past in both banking sectors so that only the merged entity or the acquiring bank remains in the sample after a take-over. As an intuitive example: assume that bank A and bank B merged in 2006 to create a new entity, bank C, then the two individual banks A and B are each included in the dataset until 2006. From 2006 onwards, these two banks' operations are considered to be terminated and the new bank (bank C) is included in the database. In the same spirit, assume that bank A was acquired by bank B in 2006; both banks are included in the database until 2006, with bank A then becoming inactive after 2006 and bank B remaining active after 2006. We obtain detailed information on mergers and acquisitions from the Zephyr database of Bureau Van Dijk's company.

All data are deflated using the GDP deflator (with 2005 as the base year) obtained from the World Bank database and represented in US Dollars. In addition to the two considerations in our data filtering process, we exclude observations of missing, negative or zero values for inputs/outputs and control variables. Our final unbalanced sample accounts for 7,585 financial institutions and 57,783 observations (whereas the balanced sample accounts for 3,076 financial institutions and 30,760 observations) for the US commercial banking sector. Table

[6] In cases where unconsolidated data were not available, we chose consolidated data instead.

4.1 presents descriptive statistics of the variables that we use in the estimation of the profit frontier kernel for the US commercial banking sector. Even though we use natural logarithms of variables in the profit kernel components (these represent the intermediation technology) in order to compute the efficiency scores, we show the mean and standard deviations in levels to be more informative.

4.5 Empirical Results

4.5.1 Transition of Banks

Tables 4.2.a, 4.3.a, 4.4.a regarding the standard profit efficiency index and 4.2.b, 4.3.b, 4.4.b regarding the risk adjusted profit index display the exact number of banks that changed position with respect to the 'pre - crisis' state of the economy and among the three Markov transition matrices ; half-tiles, quartiles, and deciles respectively. In the same spirit tables 4.5.a,b; 4.6.a,b; 4.7.a,b and 4.8.a,b; 4.9.a,b; 4.10.a.b display the exact same information with respect to during - crisis' and 'post - crisis' state of the economy. Additionally, we report the probability and the standard error for each possible location in these different matrices[7]. The empirical evidence demonstrates that in all three considered economic periods (i.e, 2003-2004 vs. 2005-2006; 2005-2006 vs. 2008-2009; 2004-2006 vs. 2010-2012) there is less deviation in

[7] We use the subscripts i and ii with respect to the tables of the probability and the standard errors of each specific movement scenario that can occur and corresponds to the table that displays the numbers of banks for each potential event. Thus tables 4.2.a.i and 4.2.a.ii represent the probability of a multinomial distribution and the standard error (computed in a multinomial distribution framework) respectively of the number of banks that move in the half-tile matrix between the 2003-2004 and 2005-2006 periods whose profit efficiency has been measured by the standard in the literature profit efficiency index.

the ordering of banks with respect to their efficient scores that derive from our suggested risk-adjusted profit efficiency index compared to the baseline index. This result is unequivocally supported in all three different Markov - matrices as well. The superiority of the risk-adjusted profit index becomes more apparent when we examine two considerably extreme scenarios of banks profit efficiency transition. To be more precise, we focus on how many banks move from the top 50% in the first time framework to the lowest position in terms of efficiency scores in the preceding time period for each respective matrix; i.e., from deciles 10, 9, 8, 7, 6; from quartiles 4,3 and from half-tile 2 in time t, to the first (i.e., 1) decile/quartile/half-tile in time $t+1$. The results indicate that fewer banks followed this extreme transition when their profit efficiency is estimated by our proposed index. This holds when we account for the reverse movement scenario as well; i.e., from the lowest 50 % to the top 10%, 25% and 50% for deciles, quartiles and half-tiles respectively. It's noteworthy that when we examine the difference in the number of banks that move in the two opposite in direction extreme (i.e., from the most efficient position to the lowest one and vice-versa) scenarios with respect to each index, each Markov matrix (i.e., decile/quartile/half-tile) gives a different results depending on the economic conditions. Precisely, the difference among the two profit indexes based on the half-tile Matrix is larger when we compare them in normal times as far as the movement from the top 50% to the lowest efficient scores is concerned, while the reverse direction (i.e., from the lowest to the highest 50% with respect to efficiency scores) exhibits its bigger difference among the two indexes in the 'pre' and 'during' the crisis comparison. The empirical evidence from the decile Markov transition matrix displays a similar picture regarding the former direction (i.e., from the lowest to the highest) while as far the reverse direction is concerned, the results highlight the superiority of the risk-adjusted index between the 'pre' and 'post' crisis comparison. As far as the quartile Markov transition matrix is concerned, the empirical evidence favours our proposed profit index among the 'pre' and 'post' crisis and during normal times comparison for 'top - bottom' and 'bottom-top' direction respectively.

4.5.2 Forecasting

Tables 4.11.a, 4.12.a, 4.13.a as far as the conventional measure of profit efficiency is concerned and 4.11.b, 4.12.b, 4.13.b as far as the proposed risk-adjusted profit efficiency index is concerned present the explanatory power of each index in three distinct 'pre - crisis' time periods ; i.e., 2003-2004, 2005-2006 and 2004-2006. Regarding the first time frame, by looking at tables 4.11.a and 4.11.b, we note that albeit both indexes are statistically significant in explaining banks' profits, we note that the model that includes the risk-adjusted profit efficiency index has smaller values in both information criterion (AIC and BIC) and slightly higher value in both R^2 and $adjR^2$. This holds in the two additional time periods 2005-2006 and 2004-2006 (see tables 4.12.a vs. 4.12.b and 4.13.a vs. 4.13.b). Tables 4.11.c 4.12.c and 4.13.c display information of the explanatory power of a model with respect to the 'pre - crisis' banks' profits that includes both profit efficiency indexes. The empirical evidence unequivocally in all three time frame highlights the fact that in the joint presence of both indexes in the model, the risk-adjusted is the only statistically significant one while the ordinary profit index becomes insignificant.

Turning to the predictive power of each index, tables 4.14.a, 4.15.a, 4.16.a regarding the standard profit efficiency measure and 4.14.b, 4.15.b, 4.16.b regarding our proposed profit efficiency measure display empirical evidence for all three different states of the economy; 'pre - crisis', 'during - crisis', 'post - crisis' respectively. As far as the first time period is concerned, where we use the estimated scores from both indexes in 2003-2004 to examine how well they explain the 'future' banks' profits in 2005-2006, the results are in favour of our index, as it has smaller values in both information criteria and it produces less mean square and absolute forecasting error (i.e., MSE and MAE) and higher R^2 and $adjR^2$ as well. As before, we present the exact same picture with respect to the superior predictive power of our index in explaining 'future' banks' profits in both 'during - crisis' (2008-2009) and 'post - crisis' (2010-2012) period by using estimated profit efficiency values in 2005-2006 and 2004-2006 respectively. In tables 4.14.c, 4.15.c and 4.16.c we present the regression results for the same empirical analysis as we did before but this time we include the estimated profit efficiency scores from both indexes simultaneously. As far the remaining two states of the economy (i.e. 'post - crisis' and 'during - crisis') are concerned, despite the fact that both indexes are found to be statistically significant in both time frameworks we note that the conventional index is insignificant at the 1% level. An intrinsic finding is that specifically in the 'during - crisis' (2008-2009) period we highlight a negative relationship between the standard profit index and the banks' profits. This result is of major importance as it violates the fundamental theoretical concepts of profit efficiency which states that the most profit efficient bank is the one that manages to adopt a profit maximizing combination of inputs and outputs (Kumbhakar and Lovell, 2000). Thus, in an oxymoron way the empirical evidence with respect to the estimated profit efficiency by the standard index indicates that an increase in banks' profit efficiency provokes a 'reduction' in banks' profits. This clearly signals the superiority of the risk - adjusted profit efficiency index.

4.5.3 Conditional Specification

Tables 4.17.a.i, 4.18.a.i, 4.19.a.i with respect to the conventional profit efficiency index and 4.17.b.i, 4.18.b.i, 4.19.b.i with respect to the risk - adjusted index shed light on the explanatory power of these indexes with regards to: the banks' profits in 2005-2006 of the financial institutions that remain solvent in 2008-2009 period, the banks' profits in 2005-2006 of the financial institutions that remain solvent in 2010-2011 period and the banks' profits in 2008-2009 of the financial institutions that remain solvent in 2010-2011 period respectively. Unequivocally, in all three cases of the 'solvent' financial institutions and in all three states of the economy as well, both indexes are found to be statistical significant, nonetheless in all cases the model that includes the risk - adjusted index has smaller values in both information criterion and higher values of both R^2 and $adjR^2$. Then we analyse the results displayed in tables 4.17.c.i, 4.18.c.i and 4.19.c.i where we include both indexes in the same model. It is noteworthy that in all cases the proposed profit efficiency index is statistically significant, whereas the conventional one only in the last category, where once again we report, an oxymoron in terms of theoretical concepts, negative relationship between the estimated profit efficiency based on the ceremonious index and the banks' profits (see Table 4.19.c.i). This finding amplifies our beliefs in the appropriateness of our suggested index. Tables 4.17.a.ii, 4.18.a.ii, 4.19.a.ii and 4.17.b.ii, 4.18.b.ii, 4.19.b.ii are differecianted in the same manner with the only difference being that they report information regarding the banks' profits of the financial institutions that they went bankrupt in the same time periods, as before in the case of the 'saved' counterparties. In line with the aforementioned set of results (i.e. the financial institutions that remained solvent throughout the different phases of the crisis) both profit efficiency indicators and in all different examined scenarios are found to contribute significantly in explaining the banks' rents of those financial intermediaries that went bankrupt in either during the crisis or in the aftermath of it. Additionally, all models that include the estimated profit efficiency levels by the risk - adjusted profit index are characterized by higher values of R^2 and adjR^2 and lower values of AIC and BIC. This supports in greater extent the superiority of our index in terms of its explanatory power. When we investigate the dynamics of the joint presence of both indexes regarding the insolvent, in the period of 'during - crisis' and 'post - crisis', financial institutions we report, in tables 4.17.c.ii, 4.18.c.ii, 4.19.c.ii, once again a negative relationship between banks profits with the profit efficiency scores estimated using the conventional approach. Moreover, we note that only the estimated risk - adjusted profit efficiency score is found to be statistically significant in all the considered cases.

Tables 4.20.a.i, 4.21.a.i, 4.22.a.i in regards to the baseline profit efficiency index and 4.20.b.i, 4.21.b.i, 4.22.b.i in regards to the new proposed index present the empirical evidence with respect to the predictive power of both indexes in the 'pre - crisis', during - crisis', 'post - crisis' respectively, as far as the banks that managed to confront the tremendous deteriorating effects of the recent financial turmoil are concerned. To be more precise, we explore the forecasting power of both indexes by using the estimated profit efficiency levels in 2005-2006 to explain the level of banks' profits in 2008-2009 and in 2010-2011 and the estimated profit efficiency scores in 2008-2009 in regards to the level of banks' rents in 2010-2011 for the banks that are found to be solvent in the aftermath of the crisis. In all these three forecasting scenarios, the results indicate that both indexes are significant from a statistical perspective point of view, nevertheless, the model that includes the estimated profit efficiency scores variable that derives from the risk adjusted index, reports in all cases smaller forecasting error, smaller values in both information criterion and higher values of R^2 and $adjR^2$. In tables 4.20.c.i, 4.21.c.i, 4.22.c.i, we report the empirical evidence when we account for both indexes in the same model. We report a statistical significant profit efficiency variable stemming from both the conventional and the risk-adjusted profit efficiency indicator in all forecasting scenarios. What is even more most interesting outcome, is the fact that in all three scenarios it is found a violation of the profit efficiency theoretical foundations with respect to the accustomed in the literature index since we report a negative relationship between the conventionally estimated profit efficiency scores and the profits of banks. Tables 4.20.a.ii, 4.21.a.ii, 4.22.a.ii as far as the commonly used profit efficiency index is concerned and 4.20.b.ii, 4.21.b.ii, 4.22.b.ii as far as the suggested index, convey the empirical evidence of the predictability power of both profit efficiency measures in all three different state of economy, regarding the banks that became insolvent either at 'during-crisis' (2008-2009) or 'post-crisis' (2010-2012) period. Specifically, we examine the forecasting power of both indexes by using the estimated profit efficiency levels first in 2005-2006 to explain the level of banks' rents of the institutions that went bankrupt just after 2009 and second in 2010-2011 in regards to the financial institutions that went bankrupt just after 2011. Additionally, we explore the predictive power of the two indexes by using the estimated profit efficiency scores in 2008-2009 with respect to the level of banks' rents in 2010-2011 for the banks that failed after 2011. As in the case of the 'saved' banks we found that in all three scenarios both indexes are found to be statistical significant, nevertheless, the model that has as an explanatory variable, the level of the estimated profit efficiency scores that derives from the risk - adjusted profit index, produces a smaller forecasting error, a smaller information criterion and a better fit of data, compared to the model that incorporates the estimates of the standard profit efficiency index as one of its explanatory variable with respect to the rents of the banks whose financial stability was fatally affected by the recent financial turmoil. Last but not least, we explore the empirical evidence of having both indexes as explanatory variables within the same model for the same three aforementioned scenarios. The results presented in tables 4.20.c.ii, 4.21.c.ii, 4.22.c.ii, highlight the superiority of our index in two ways: On one hand, the coexistence of both indexes produces the following inference: an increase in the banks' level of profit efficiency measured by the conventional index, reduces the bank' rents, while our suggested profit efficiency measure keeps its positive fundamental relationship with the banks' profits. On the other hand, estimates of profit efficiency scores based on our index are found to be statistically significant in all three forecasting scenarios, whereas this is rejected as far the estimated profit efficiency scores in 2005-2006 stemming from the standard index (simultaneously with the respective ones of the new index) are used to explain banks' level or rents in 2008-2009 of those financial institutions that became insolvent just after 2009 (see table 4.20.c.ii).

4.5.4 Robustness checks

In order to test the precision of our empirical findings we conduct various robustness tests. First of all following Berger and Mester (1997) who highlight the importance of controlling for equity as its absence could yield a scale bias, and the efficiency of banks could be mismeasured even if they behave optimally given their risk preferences, we include equity as a quasi-fixed input to control for differences in risk preferences. The results remained unchanged in all three steps of empirical strategy. It is acknowledged that equity capital is used in the construction of our suggested risk - adjusted profit efficiency index, consequently, in order to account for any endogeneity concerns we include equity capital as an input only in the standard profit index. Once again our inferences did not change significantly with respect to our three-step procedure of empirical analysis. Second we included in both the estimation of both indexes a time trend (t) in each specification to allow for technological change, using both linear and quadratic terms (t^2). The results remained unaffected. Third, we used an alternative method (Berger and Mester 1997) to account for the banks' year observations that exhibit negative profits (i.e. losses) to the one of Bos and Koetter (2011) and we estimate each single point in the aforementioned empirical strategy. Precisely, the dependent variable in the profit model is transformed to

$$ln(PBT+ \mid (PBT)^{\min} \mid +1)$$

where $\mid (PBT)^{\min} \mid$ is the minimum absolute value of PBT over all banks in the sample. The empirical evidence confirms consistency with respect to the ordering of the banks' estimated profit efficiency scores among both methods. Last but not least, we repeat each part of our empirical strategy and in addition each one of the aforementioned robustness points, by estimating both profit efficiency scores of both indexes by using a multi-product translog specification instead of the less flexible Cobb - Douglas function. Most of the core results remain unchanged[8]. Thus we are confident that the aforementioned empirical inferences which highlight the higher explanatory and predictability power as well of our suggested risk - adjusted profit efficiency measure, are extracted with a high degree of confidence.

4.6 Conclusion

The recent financial turmoil has distorted the stability of various banking systems and triggered numerous bank failures even of financial institutions that were considered highly efficient. In this paper we attempt to shed light on the trade - off between financial stability and efficiency. We highlight that current tests of banking efficiency do not take into account whether bank managers are taking too much or too little risk relative to the value maximising amount. With this in mind, a new risk-adjusted profit efficiency measure is proposed which accounts for the level of each bank's credit risk and leverage. We apply a three step comparison between the conventional profit efficiency measure and our risk - adjusted profit efficiency index in a sample of US commercial banks. First we examine the robustness of the bank-specific profit efficiency scores these indexes produce within three different states of the economy; 'pre - crisis', 'during - crisis', 'post - crisis'. Second, we explore which index explains more accurately banks' profits in three different 'pre - crisis' time periods; i.e., 2003-2004, 2005-2006 and 2004-2006. Additionally, we compare their forecasting power by examining which of the measure captures better the growth of future banks' rents.

[8] In a few cases as far as the failed institutions in the post crisis scenario are concerned, convergence was failed due to a limited sample, since fewer banks became insolvent after 2011 and the post crisis scenario consists only of two year-observations (i.e 2010, 2011).

Last but not least, we compare the explanatory and forecasting power of both profit efficiency measures with respect to two different banks' categories: financial institutions that failed either during the crisis or during the aftermath of the crisis and financial institutions that remain solvent uo to present.

The empirical evidence illustrated by the Markov transition matrices indicates that in all three considered economic periods (i.e., 2003-2004 vs. 2005-2006; 2005-2006 vs. 2008-2009; 2004-2006 vs. 2010-2012) the new risk - adjusted profit efficiency index produces considerably more robust bank-specific estimates than the standard index especially in extreme scenarios. In other words, for all three stages around the crisis, the variance of profit efficiency estimates derived by our proposed risk-adjusted indicator is considerably smaller than the one that is produced by the conventional indicator or profit efficiency. Moreover, the results indicate that a model which has as an explanatory variable profit efficiency estimates deriving from our proposed index has both superior explanatory and predictive power in all periods around the crisis. The 'new' risk-adjusted profit efficiency measure has the edge with respect to the explanatory and forecasting power of both solvent and insolvent financial institutions' profits as well. Our extracted empirical inferences remain unchanged after various robustness tests. The main policy implication of our suggested index is that it suggests that moving from an intermediary bank type balance sheet to an investment bank type not only changes the risk-return combination of the balance sheet but also increases the banks' degree of instability, that is the probability of insolvency when adverse effects occur. Therefore, regulatory authorities may need to exert caution in assessing the efficiency of banks, a prerequisite for the financial stability.

4.7 Appendix

Table 4.1: Descriptive Statistics of the variables of interest.

Kernel Variable		Mean	St. Dev	Percentiles	
				5th	95th
Profit before tax	PBT	392.932	38.422	317.365	468.499
Price of borrowed funds	p1	0.0199	0.0003	0.0192	0.0205
Price of labor	p2	0.0586	0.0001	0.0584	0.0588
Price of physical capital	p3	1.2709	0.0333	1.2058	1.3361
Total loans	q1	996.3432	63.2001	872.4707	1120.216
Total earning assets	q2	523.6729	53.5262	418.7613	628.5846
Credit Risk	σ1	0.0189	63.2001	0.01863	0.0192
Leverage	σ2	10.4105	0.0286	10.3543	10.4666

Notes: This table refers to 57,597 observations and 7,585 US commercial banks between 2003-2012. The table reports descriptive statistics of the kernel variables used in the estimation of the stochastic profit frontier model. All variables are deflated using 2005 as a base year. Kernel variables consist of the dependent variable, i.e. profits before tax (PBT), inputs prices (p), output quantities (q) and the two risk indicators (σ).

Table 4.2.a - Number of Banks (Half-tiles)

2003-2004		
1	1211	327
2	327	1211
2005-2006	1	2

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2003-2004 to 2005-2006. The model is

ln(PBT{it})=f(p{it},q{it})+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Half-tile '1' and '2' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.2.a.i - Probability of each event (%)

2003-2004		
1	39.37	10.63
2	10.63	39.37
2005-2006	1	2

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.2.a.

Table 4.2.a.ii - Standard error of each prob.

2003-2004		
1	0.49	0.31
2	0.31	0.49
2005-2006	1	2

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.2.a and 4.2.a.i.

Table 4.2.b - Number of Banks (Half-tiles)

2003-2004		
1	1195	343
2	343	1195
2005-2006	1	2

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the risk-adjusted index from the sub-period 2003-2004 to 2005-2006. The model is

ln(PBT{it}/σ)=f(p{it},q{it})+NPLs{it}/TLs{it}+L+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. 'NPLs' (i.e. Non-Performing Loans) and 'L' (i.e. Leverage) account for an ex post' and 'ex-ante' indicator of risk respectively. Half-tile '1' and 2' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.2.b.i - Probability of each event (%)

2003-2004		
1	38.85	11.15
2	11.15	38.85
2005-2006	1	2

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.2.b.

Table 4.2.b.ii - Standard error of each prob.

2003-2004		
1	0.49	0.31
2	0.31	0.49
2005-2006	1	2

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.2.b and 4.2.b.i.

Table 4.3.a - Number of Banks (Quartiles)

2003-2004				
1	519	181	55	14
2	171	340	199	59
3	57	195	336	181
4	22	53	179	515
2005-2006	1	2	3	4

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2003-2004 to 2005-2006. The model is

$$\ln(PBT\{it\})=f(p\{it\},q\{it\})+v\{it\}-u\{it\}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Quartile '1' and '4' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.3.a.i - Probability of each event (%)

2003-2004				
1	16.87	5.88	1.79	0.46
2	5.56	11.05	6.47	1.92
3	1.85	6.34	10.92	5.88
4	0.72	1.72	5.82	16.74
2005-2006	1	2	3	4

Note: This table reports the banks' probability of transition to each specific quartile as explained in table 4.3.a.

Table 4.3.a.ii - Standard error of each prob.

2003-2004				
1	0.37	0.24	0.13	0.07
2	0.23	0.31	0.25	0.14
3	0.13	0.24	0.31	0.24
4	0.08	0.13	0.23	0.37
2005-2006	1	2	3	4

Note: This table reports the standard error of the banks' probability of transition to each specific quartile as explained in tables 4.3.a and 4.3.a.i.

Table 4.3.b - Number of Banks (Quartiles)

2003-2004				
1	517	174	66	12
2	169	335	191	74
3	60	200	330	179
4	23	60	182	504
2005-2006	1	2	3	4

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the risk-adjusted index from the sub-period 2003-2004 to 2005-2006. The model is

ln(PBT{it}/σ)=f(p{it},q{it})+NPLs{it}/TLs{it}+L+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. 'NPLs' (i.e. Non-Performing Loans) and 'L' (i.e. Leverage) account for an ex post' and 'ex-ante' indicator of risk respectively. Quartile '1' and 4' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.3.b.i - Probability of each event (%)

2003-2004				
1	16.81	5.66	2.15	0.39
2	5.49	10.89	6.21	2.41
3	1.95	6.5	10.73	5.82
4	0.75	1.95	5.92	16.38
2005-2006	1	2	3	4

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.3.b.

Table 4.3.b.ii - Standard error of each prob.

2003-2004				
1	0.37	0.23	0.14	0.06
2	0.23	0.31	0.24	0.15
3	0.14	0.25	0.31	0.23
4	0.09	0.14	0.24	0.37
2005-2006	1	2	3	4

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.3.b and 4.3.b.i.

Table 4.4.a - Number of Banks (Deciles)

2003-2004										
1	161	60	27	26	13	4	8	2	4	2
2	69	96	62	36	21	13	7	1	2	0
3	30	64	71	48	33	29	10	16	5	1
4	12	31	48	52	67	31	31	22	10	5
5	12	25	40	58	50	54	23	25	16	6
6	9	16	20	32	50	65	41	38	31	7
7	3	4	18	29	31	50	77	52	28	16
8	9	6	12	18	29	34	50	62	61	26
9	0	1	7	7	9	19	44	60	92	68
10	3	4	2	2	6	10	17	29	58	176
2005-2006	1	2	3	4	5	6	7	8	9	10

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2003-2004 to 2005-2006. The model is

ln(PBT{it})=f(p{it},q{it})+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Decile '1' and '10' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.4.a.i - Probability of each event (%)

2003-2004										
1	5.23	1.95	0.88	0.85	0.42	0.13	0.26	0.07	0.13	0.07
2	2.24	3.12	2.02	1.17	0.68	0.42	0.23	0.03	0.07	0
3	0.98	2.08	2.31	1.56	1.07	0.94	0.33	0.52	0.16	0.03
4	0.39	1.01	1.56	1.69	2.18	1.01	1.01	0.72	0.33	0.16
5	0.39	0.81	1.3	1.89	1.63	1.76	0.75	0.81	0.52	0.2
6	0.29	0.52	0.65	1.04	1.63	2.11	1.33	1.24	1.01	0.23
7	0.1	0.13	0.59	0.94	1.01	1.63	2.5	1.69	0.91	0.52
8	0.29	0.2	0.39	0.59	0.94	1.11	1.63	2.02	1.98	0.85
9	0	0.03	0.23	0.23	0.29	0.62	1.43	1.95	2.99	2.21
10	0.1	0.13	0.07	0.07	0.2	0.33	0.55	0.94	1.89	5.72
2005-2006	1	2	3	4	5	6	7	8	9	10

Note: This table reports the banks' probability of transition to each specific decile as explained in table 4.4.a.

Table 4.4.a.ii - Standard error of each prob.

2003-2004										
1	0.22	0.14	0.09	0.09	0.06	0.04	0.05	0.03	0.04	0.03
2	0.15	0.17	0.14	0.11	0.08	0.06	0.05	0.02	0.03	0
3	0.1	0.14	0.15	0.12	0.1	0.1	0.06	0.07	0.04	0.02
4	0.06	0.1	0.12	0.13	0.15	0.1	0.1	0.08	0.06	0.04
5	0.06	0.09	0.11	0.14	0.13	0.13	0.09	0.09	0.07	0.04
6	0.05	0.07	0.08	0.1	0.13	0.14	0.11	0.11	0.1	0.05
7	0.03	0.04	0.08	0.1	0.1	0.13	0.16	0.13	0.09	0.07
8	0.05	0.04	0.06	0.08	0.1	0.1	0.13	0.14	0.14	0.09
9	0	0.02	0.05	0.05	0.05	0.08	0.12	0.14	0.17	0.15
10	0.03	0.04	0.03	0.03	0.04	0.06	0.07	0.1	0.14	0.23
2005-2006	1	2	3	4	5	6	7	8	9	10

Note: This table reports the standard error of the banks' probability of transition to each specific decile as explained in tables 4.4.a and 4.4.a.i.

Table 4.4.b - Number of Banks (Deciles)

2003-2004										
1	157	66	28	21	12	8	7	4	0	4
2	75	90	62	29	22	18	7	2	2	0
3	27	67	70	47	32	20	24	11	8	1
4	19	30	47	64	52	39	29	17	5	6
5	10	18	30	54	66	45	27	30	19	10
6	4	21	31	31	46	60	54	25	28	9
7	6	1	19	34	37	41	54	55	43	18
8	6	7	9	16	24	47	55	66	52	25
9	0	4	6	10	14	21	35	66	88	63
10	3	3	5	2	4	10	16	31	62	171
2005-2006	1	2	3	4	5	6	7	8	9	10

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2003-2004 to 2005-2006. The model is

$$\ln(PBT_{it}/\sigma)=f(p_{it},q_{it})+NPLs_{it}/TLs_{it}+L+v_{it}-u_{it}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Decile '1' and '10' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.4.b.i - Probability of each event (%)

2003-2004										
1	5.1	2.15	0.91	0.68	0.39	0.26	0.23	0.13	0	0.13
2	2.44	2.93	2.02	0.94	0.72	0.59	0.23	0.07	0.07	0
3	0.88	2.18	2.28	1.53	1.04	0.65	0.78	0.36	0.26	0.03
4	0.62	0.98	1.53	2.08	1.69	1.27	0.94	0.55	0.16	0.2
5	0.33	0.59	0.98	1.76	2.15	1.46	0.88	0.98	0.62	0.33
6	0.13	0.68	1.01	1.01	1.5	1.95	1.76	0.81	0.91	0.29
7	0.2	0.03	0.62	1.11	1.2	1.33	1.76	1.79	1.4	0.59
8	0.2	0.23	0.29	0.52	0.78	1.53	1.79	2.15	1.69	0.81
9	0	0.13	0.2	0.33	0.46	0.68	1.14	2.15	2.86	2.05
10	0.1	0.1	0.16	0.07	0.13	0.33	0.52	1.01	2.02	5.56
2005-2006	1	2	3	4	5	6	7	8	9	10

Note: This table reports the banks' probability of transition to each specific decile as explained in table 4.4.b.

Table 4.4.b.ii - Standard error of each prob.

2003-2004										
1	0.22	0.14	0.09	0.08	0.06	0.05	0.05	0.04	0	0.04
2	0.15	0.17	0.14	0.1	0.08	0.08	0.05	0.03	0.03	0
3	0.09	0.15	0.15	0.12	0.1	0.08	0.09	0.06	0.05	0.02
4	0.08	0.1	0.12	0.14	0.13	0.11	0.1	0.07	0.04	0.04
5	0.06	0.08	0.1	0.13	0.14	0.12	0.09	0.1	0.08	0.06
6	0.04	0.08	0.1	0.1	0.12	0.14	0.13	0.09	0.09	0.05
7	0.04	0.02	0.08	0.1	0.11	0.11	0.13	0.13	0.12	0.08
8	0.04	0.05	0.05	0.07	0.09	0.12	0.13	0.14	0.13	0.09
9	0	0.04	0.04	0.06	0.07	0.08	0.11	0.14	0.17	0.14
10	0.03	0.03	0.04	0.03	0.04	0.06	0.07	0.1	0.14	0.23
2005-2006	1	2	3	4	5	6	7	8	9	10

Note: This table reports the standard error of the banks' probability of transition to each specific decile as explained in tables 4.4.b and 4.4.b.i.

Table 4.5.a - Number of Banks (Half-tiles)

2005-2006		
1	1053	485
2	485	1053
2008-2009	1	2

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2005-2006 to 2008-2009. The model is

ln(PBT{it})=f(p{it},q{it})+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Half-tile '1' and '2' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.5.a.i - Probability of each event (%)

2005-2006		
1	34.23	15.77
2	15.77	34.23
2008-2009	1	2

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.5.a.

Table 4.5.a.ii - Standard error of each prob.

2005-2006		
1	0.47	0.36
2	0.36	0.47
2008-2009	1	2

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.5.a and 4.5.a.i.

Table 4.5.b - Number of Banks (Half-tiles)

2005-2006		
1	1056	456
2	482	1059
2008-2009		

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the risk-adjusted index from the sub-period 2005-2006 to 2008-2009. The model is

$$\ln(PBT_{it}/\sigma)=f(p_{it},q_{it})+NPLs_{it}/TLs_{it}+L+v_{it}-u_{it}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. 'NPLs' (i.e. Non-Performing Loans) and 'L' (i.e. Leverage) account for an ex post' and 'ex-ante' indicator of risk respectively. Half-tile '1' and 2' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.5.b.i - Probability of each event (%)

2005-2006		
1	34.33	14.82
2	15.67	34.43
2008-2009	1	2

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.5.b.

Table 4.5.b.ii - Standard error of each prob.

2005-2006		
1	0.47	0.36
2	0.36	0.48
2008-2009	1	2

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.5.b and 4.5.b.i.

Table 4.6.a - Number of Banks (Quartiles)

2005-2006				
1	379	252	100	38
2	187	235	235	112
3	126	169	259	215
4	77	113	175	404
2008-2009	1	2	3	4

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2005-2006 to 2008-2009. The model is

ln(PBT{it})=f(p{it},q{it})+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Quartile '1' and '4' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.6.a.i - Probability of each event (%)

2005-2006				
1	12.32	8.19	3.25	1.24
2	6.08	7.64	7.64	3.64
3	4.1	5.49	8.42	6.99
4	2.5	3.67	5.69	13.13
2008-2009	1	2	3	4

Note: This table reports the banks' probability of transition to each specific quartile as explained in table 4.6.a.

Table 4.6.a.ii - Standard error of each prob.

2005-2006				
1	0.33	0.27	0.18	0.11
2	0.24	0.27	0.27	0.19
3	0.2	0.23	0.28	0.25
4	0.16	0.19	0.23	0.34
2008-2009	1	2	3	4

Note: This table reports the standard error of the banks' probability of transition to each specific quartile as explained in tables 4.6.a and 4.6.a.i.

Table 4.6.b - Number of Banks (Quartiles)

2003-2004				
1	391	241	97	40
2	179	245	231	114
3	124	169	267	209
4	75	114	174	406
2005-2006	1	2	3	4

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the risk-adjusted index from the sub-period 2005-2006 to 2008-2009. The model is

ln(PBT{it}/σ)=f(p{it},q{it})+NPLs{it}/TLs{it}+L+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. 'NPLs' (i.e. Non-Performing Loans) and 'L' (i.e. Leverage) account for an ex post' and 'ex-ante' indicator of risk respectively. Quartile '1' and 4' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.6.b.i - Probability of each event (%)

2003-2004				
1	12.71	7.83	3.15	1.3
2	5.82	7.96	7.51	3.71
3	4.03	5.49	8.68	6.79
4	2.44	3.71	5.66	13.2
2005-2006	1	2	3	4

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.6.b.

Table 4.6.b.ii - Standard error of each prob.

2003-2004				
1	0.33	0.27	0.17	0.11
2	0.23	0.27	0.26	0.19
3	0.2	0.23	0.28	0.25
4	0.15	0.19	0.23	0.34
2005-2006	1	2	3	4

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.6.b and 4.6.b.i.

Table 4.7.a - Number of Banks (Deciles)

2005-2006										
1	106	72	41	36	22	8	6	12	2	2
2	47	56	54	47	36	31	16	13	5	2
3	31	37	40	51	49	32	27	26	13	1
4	29	25	41	42	37	38	35	24	28	9
5	28	25	33	33	35	39	40	41	26	9
6	16	28	32	27	35	43	45	42	30	11
7	18	18	18	25	28	37	51	44	46	23
8	14	18	17	20	28	33	31	44	62	40
9	8	13	20	13	27	24	29	36	54	83
10	10	15	11	14	12	24	28	25	41	127
2008-2009	1	2	3	4	5	6	7	8	9	10

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2005-2006 to 2008-2009. The model is

ln(PBT{it})=f(p{it},q{it})+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Decile '1' and '10' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.7.a.i - Probability of each event (%)

2005-2006										
1	3.45	2.34	1.33	1.17	0.72	0.26	0.2	0.39	0.07	0.07
2	1.53	1.82	1.76	1.53	1.17	1.01	0.52	0.42	0.16	0.07
3	1.01	1.2	1.3	1.66	1.59	1.04	0.88	0.85	0.42	0.03
4	0.94	0.81	1.33	1.37	1.2	1.24	1.14	0.78	0.91	0.29
5	0.91	0.81	1.07	1.07	1.14	1.27	1.3	1.33	0.85	0.29
6	0.52	0.91	1.04	0.88	1.14	1.4	1.46	1.37	0.98	0.36
7	0.59	0.59	0.59	0.81	0.91	1.2	1.66	1.43	1.5	0.75
8	0.46	0.59	0.55	0.65	0.91	1.07	1.01	1.43	2.02	1.3
9	0.26	0.42	0.65	0.42	0.88	0.78	0.94	1.17	1.76	2.7
10	0.33	0.49	0.36	0.46	0.39	0.78	0.91	0.81	1.33	4.13
2008-2009	1	2	3	4	5	6	7	8	9	10

Note: This table reports the banks' probability of transition to each specific decile as explained in table 4.7.a.

Table 4.7.a.ii - Standard error of each prob.

2005-2006										
1	0.18	0.15	0.11	0.11	0.08	0.05	0.04	0.06	0.03	0.03
2	0.12	0.13	0.13	0.12	0.11	0.1	0.07	0.06	0.04	0.03
3	0.1	0.11	0.11	0.13	0.13	0.1	0.09	0.09	0.06	0.02
4	0.1	0.09	0.11	0.12	0.11	0.11	0.11	0.09	0.09	0.05
5	0.09	0.09	0.1	0.1	0.11	0.11	0.11	0.11	0.09	0.05
6	0.07	0.09	0.1	0.09	0.11	0.12	0.12	0.12	0.1	0.06
7	0.08	0.08	0.08	0.09	0.09	0.11	0.13	0.12	0.12	0.09
8	0.07	0.08	0.07	0.08	0.09	0.1	0.1	0.12	0.14	0.11
9	0.05	0.06	0.08	0.06	0.09	0.09	0.1	0.11	0.13	0.16
10	0.06	0.07	0.06	0.07	0.06	0.09	0.09	0.09	0.11	0
2008-2009	1	2	3	4	5	6	7	8	9	10

Note: This table reports the standard error of the banks' probability of transition to each specific decile as explained in tables 4.7.a and 4.7.a.i.

Table 4.7.b - Number of Banks (Deciles)

2005-2006										
1	100	84	40	34	19	11	4	4	9	2
2	53	54	50	45	39	29	12	16	5	4
3	28	37	52	54	46	25	33	20	11	1
4	31	24	37	44	41	40	37	25	20	9
5	24	23	33	28	36	43	44	35	32	11
6	19	28	26	23	38	42	50	42	35	6
7	21	20	23	24	25	39	42	44	39	31
8	16	15	16	21	23	31	36	61	52	36
9	8	14	21	13	23	27	26	37	58	80
10	7	8	9	22	19	22	24	23	46	127
2008-2009	1	2	3	4	5	6	7	8	9	10

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2005-2006 to 2008-2009. The model is

$$\ln(PBT\{it\}/\sigma)=f(p\{it\},q\{it\})+NPLs\{it\}/TLs\{it\}+L+v\{it\}-u\{it\}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Decile '1' and '10' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.7.b.i - Probability of each event (%)

2005-2006										
1	3.25	2.73	1.3	1.11	0.62	0.36	0.13	0.13	0.29	0.07
2	1.72	1.76	1.63	1.46	1.27	0.94	0.39	0.52	0.16	0.13
3	0.91	1.2	1.69	1.76	1.5	0.81	1.07	0.65	0.36	0.03
4	1.01	0.78	1.2	1.43	1.33	1.3	1.2	0.81	0.65	0.29
5	0.78	0.75	1.07	0.91	1.17	1.4	1.43	1.14	1.04	0.36
6	0.62	0.91	0.85	0.75	1.24	1.37	1.63	1.37	1.14	0.2
7	0.68	0.65	0.75	0.78	0.81	1.27	1.37	1.43	1.27	1.01
8	0.52	0.49	0.52	0.68	0.75	1.01	1.17	1.98	1.69	1.17
9	0.26	0.46	0.68	0.42	0.75	0.88	0.85	1.2	1.89	2.6
10	0.23	0.26	0.29	0.72	0.62	0.72	0.78	0.75	1.5	4.13
2008-2009	1	2	3	4	5	6	7	8	9	10

Note: This table reports the banks' probability of transition to each specific decile as explained in table 4.7.b.

Table 4.7.b.ii - Standard error of each prob.

2005-2006										
1	0.18	0.16	0.11	0.1	0.08	0.06	0.04	0.04	0.05	0.03
2	0.13	0.13	0.13	0.12	0.11	0.1	0.06	0.07	0.04	0.04
3	0.09	0.11	0.13	0.13	0.12	0.09	0.1	0.08	0.06	0.02
4	0.1	0.09	0.11	0.12	0.11	0.11	0.11	0.09	0.08	0.05
5	0.09	0.09	0.1	0.09	0.11	0.12	0.12	0.11	0.1	0.06
6	0.08	0.09	0.09	0.09	0.11	0.12	0.13	0.12	0.11	0.04
7	0.08	0.08	0.09	0.09	0.09	0.11	0.12	0.12	0.11	0.1
8	0.07	0.07	0.07	0.08	0.09	0.1	0.11	0.14	0.13	0.11
9	0.05	0.07	0.08	0.06	0.09	0.09	0.09	0.09	0.11	0.14	0.16
10	0.05	0.05	0.05	0.08	0.08	0.08	0.09	0.09	0.12	0.2
2008-2009	1	2	3	4	5	6	7	8	9	10

Note: This table reports the standard error of the banks' probability of transition to each specific decile as explained in tables 4.7.b and 4.7.b.i.

Table 4.8.a - Number of Banks (Half-tiles)

2004-2006		
1	993	545
2	545	993
2010-2012	1	2

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2004-2006 to 2010-2012. The model is

$$\ln(PBT\{it\})=f(p\{it\},q\{it\})+v\{it\}-u\{it\}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Half-tile '1' and '2' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.8.a.i - Probability of each event (%)

2004-2006		
1	32.28	17.72
2	17.72	32.28
2010-2012	1	2

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.8.a.

Table 4.8.a.ii - Standard error of each prob.

2004-2006		
1	0.47	0.38
2	0.38	0.47
2010-2012	1	2

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.8.a and 4.8.a.i.

Table 4.8.b - Number of Banks (Half-tiles)

2004-2006		
1	1019	519
2	519	1019
2010-2012	1	2

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the risk-adjusted index from the sub-period 2004-2006 to 2010-2012. The model is

ln(PBT{it}/σ)=f(p{it},q{it})+NPLs{it}/TLs{it}+L+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. 'NPLs' (i.e. Non-Performing Loans) and 'L' (i.e. Leverage) account for an ex post' and 'ex-ante' indicator of risk respectively. Half-tile '1' and 2' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.8.b.i - Probability of each event (%)

2004-2006		
1	33.13	16.87
2	16.87	33.13
2010-2012	1	2

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.8.b.

Table 4.8.b.ii - Standard error of each prob.

2004-2006		
1	0.47	0.37
2	0.37	0.47
2010-2012	1	2

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.8.b and 4.8.b.i.

Table 4.9.a - Number of Banks (Quartiles)

2004-2006				
1	342	250	134	43
2	179	222	233	135
3	131	168	249	221
4	117	129	153	370
2010-2012	1	2	3	4

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2004-2006 to 2010-2012. The model is

ln(PBT{it})=f(p{it},q{it})+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Quartile '1' and '4' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.9.a.i - Probability of each event (%)

2004-2006				
1	11.12	8.13	4.36	1.4
2	5.82	7.22	7.57	4.39
3	4.26	5.46	8.09	7.18
4	3.8	4.19	4.97	12.03
2010-2012	1	2	3	4

Note: This table reports the banks' probability of transition to each specific quartile as explained in table 4.9.a.

Table 4.9.a.ii - Standard error of each prob.

2004-2006				
1	0.31	0.27	0.2	0.12
2	0.23	0.26	0.26	0.2
3	0.2	0.23	0.27	0.26
4	0.19	0.2	0.22	0.33
2010-2012	1	2	3	4

Note: This table reports the standard error of the banks' probability of transition to each specific quartile as explained in tables 4.9.a and 4.9.a.i.

Table 4.9.b - Number of Banks (Quartiles)

2004-2006				
1	375	235	108	51
2	160	249	225	135
3	122	158	262	227
4	112	127	174	356
2010-2012	1	2	3	4

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the risk-adjusted index from the sub-period 2004-2006 to 2010-2012. The model is

ln(PBT{it}/σ)=f(p{it},q{it})+NPLs{it}/TLs{it}+L+v{it}-u{it}

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. 'NPLs' (i.e. Non-Performing Loans) and 'L' (i.e. Leverage) account for an ex post' and 'ex-ante' indicator of risk respectively. Quartile '1' and 4' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.9.b.i - Probability of each event (%)

2004-2006				
1	12.19	7.64	3.51	1.66
2	5.2	8.09	7.31	4.39
3	3.97	5.14	8.52	7.38
4	3.64	4.13	5.66	11.57
2010-2012	1	2	3	4

Note: This table reports the banks' probability of transition to each specific half-tile as explained in table 4.9.b.

Table 4.9.b.ii - Standard error of each prob.

2004-2006				
1	0.33	0.27	0.18	0.13
2	0.22	0.27	0.26	0.2
3	0.2	0.22	0.28	0.26
4	0.19	0.2	0.23	0.32
2010-2012	1	2	3	4

Note: This table reports the standard error of the banks' probability of transition to each specific half-tile as explained in tables 4.9.b and 4.9.b.i.

Table 4.10.a - Number of Banks (Deciles)

2004-2006										
1	83	69	50	43	25	17	6	2	7	5
2	49	36	52	57	34	30	25	12	8	4
3	28	36	38	37	45	53	22	22	16	10
4	25	36	25	28	48	40	36	31	25	14
5	24	31	32	22	40	39	46	29	27	19
6	17	31	24	30	32	41	38	43	37	16
7	24	19	24	20	28	32	42	40	42	37
8	21	16	21	23	25	24	35	45	53	44
9	14	15	20	26	15	21	36	53	48	59
10	22	18	21	22	17	12	22	30	44	99
2010-2012	1	2	3	4	5	6	7	8	9	10

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2004-2006 to 2010-2012. The model is

$$\ln(PBT\{it\})=f(p\{it\},q\{it\})+v\{it\}-u\{it\}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Decile '1' and '10' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.10.a.i - Probability of each event (%)

2004-2006										
1	2.7	2.24	1.63	1.4	0.81	0.55	0.2	0.07	0.23	0.16
2	1.59	1.17	1.69	1.85	1.11	0.98	0.81	0.39	0.26	0.13
3	0.91	1.17	1.24	1.2	1.46	1.72	0.72	0.72	0.52	0.33
4	0.81	1.17	0.81	0.91	1.56	1.3	1.17	1.01	0.81	0.46
5	0.78	1.01	1.04	0.72	1.3	1.27	1.5	0.94	0.88	0.62
6	0.55	1.01	0.78	0.98	1.04	1.33	1.24	1.4	1.2	0.52
7	0.78	0.62	0.78	0.65	0.91	1.04	1.37	1.3	1.37	1.2
8	0.68	0.52	0.68	0.75	0.81	0.78	1.14	1.46	1.72	1.43
9	0.46	0.49	0.65	0.85	0.49	0.68	1.17	1.72	1.56	1.92
10	0.72	0.59	0.68	0.72	0.55	0.39	0.72	0.98	1.43	3.22
2010-2012	1	2	3	4	5	6	7	8	9	10

Note: This table reports the banks' probability of transition to each specific decile as explained in table 4.10.a.

Table 4.10.a.ii - Standard error of each prob.

2004-2006										
1	0.16	0.15	0.13	0.12	0.09	0.07	0.04	0.03	0.05	0.04
2	0.13	0.11	0.13	0.13	0.1	0.1	0.09	0.06	0.05	0.04
3	0.09	0.11	0.11	0.11	0.12	0.13	0.08	0.08	0.07	0.06
4	0.09	0.11	0.09	0.09	0.12	0.11	0.11	0.1	0.09	0.07
5	0.09	0.1	0.1	0.08	0.11	0.11	0.12	0.1	0.09	0.08
6	0.07	0.1	0.09	0.1	0.1	0.11	0.11	0.12	0.11	0.07
7	0.09	0.08	0.09	0.08	0.09	0.1	0.12	0.11	0.12	0.11
8	0.08	0.07	0.08	0.09	0.09	0.09	0.11	0.12	0.13	0.12
9	0.07	0.07	0.08	0.09	0.07	0.08	0.11	0.13	0.12	0.14
10	0.08	0.08	0.08	0.08	0.07	0.06	0.08	0.1	0.12	0.18
2010-2012	1	2	3	4	5	6	7	8	9	10

Note: This table reports the standard error of the banks' probability of transition to each specific decile as explained in tables 4.10.a and 4.10.a.i.

Table 4.10.b - Number of Banks (Deciles)

2004-2006										
1	89	77	44	36	24	16	4	5	5	7
2	58	46	54	42	37	24	16	15	9	6
3	30	38	38	40	51	34	30	17	13	16
4	23	35	23	45	41	47	38	26	25	5
5	14	25	30	41	38	33	40	39	31	18
6	24	24	24	17	35	46	47	37	31	24
7	18	20	23	29	27	35	41	37	50	28
8	13	10	25	22	18	38	39	46	54	42
9	20	19	19	20	17	26	36	46	47	57
10	18	13	27	16	21	10	17	39	42	104
2010-2012	1	2	3	4	5	6	7	8	9	10

Note: This table presents information about the number of banks that changed their relative position with respect to their profit efficiency ranking deriving from the standard index from the sub-period 2004-2006 to 2010-2012. The model is

$$\ln(PBT_{it}/\sigma)=f(p_{it},q_{it})+NPLs_{it}/TLs_{it}+L+v_{it}-u_{it}$$

where the dependent variable PBT represents profit before tax (PBT) and the independent variables p and q reflect inputs prices (i.e. borrowed funds, labor and physical capital) and output quantities (i.e. loans and earning assets) respectively. Decile '1' and '10' consists of banks with the lowest and highest profit efficiency levels respectively.

Table 4.10.b.i - Probability of each event (%)

2004-2006										
1	2.89	2.5	1.43	1.17	0.78	0.52	0.13	0.16	0.16	0.23
2	1.89	1.5	1.76	1.37	1.2	0.78	0.52	0.49	0.29	0.2
3	0.98	1.24	1.24	1.3	1.66	1.11	0.98	0.55	0.42	0.52
4	0.75	1.14	0.75	1.46	1.33	1.53	1.24	0.85	0.81	0.16
5	0.46	0.81	0.98	1.33	1.24	1.07	1.3	1.27	1.01	0.59
6	0.78	0.78	0.78	0.55	1.14	1.5	1.53	1.2	1.01	0.78
7	0.59	0.65	0.75	0.94	0.88	1.14	1.33	1.2	1.63	0.91
8	0.42	0.33	0.81	0.72	0.59	1.24	1.27	1.5	1.76	1.37
9	0.65	0.62	0.62	0.65	0.55	0.85	1.17	1.5	1.53	1.85
10	0.59	0.42	0.88	0.52	0.68	0.33	0.55	1.27	1.37	3.38
2010-2012	1	2	3	4	5	6	7	8	9	10

Note: This table reports the banks' probability of transition to each specific decile as explained in table 4.10.b.

Table 4.10.b.ii - Standard error of each prob.

2004-2006										
1	0.17	0.16	0.12	0.11	0.09	0.07	0.04	0.04	0.04	0.05
2	0.14	0.12	0.13	0.12	0.11	0.09	0.07	0.07	0.05	0.04
3	0.1	0.11	0.11	0.11	0.13	0.1	0.1	0.07	0.06	0.07
4	0.09	0.11	0.09	0.12	0.11	0.12	0.11	0.09	0.09	0.04
5	0.07	0.09	0.1	0.11	0.11	0.1	0.11	0.11	0.1	0.08
6	0.09	0.09	0.09	0.07	0.11	0.12	0.12	0.11	0.1	0.09
7	0.08	0.08	0.09	0.1	0.09	0.11	0.11	0.11	0.13	0.09
8	0.06	0.06	0.09	0.08	0.08	0.11	0.11	0.12	0.13	0.12
9	0.08	0.08	0.08	0.08	0.07	0.09	0.11	0.12	0.12	0.13
10	0.08	0.06	0.09	0.07	0.08	0.06	0.07	0.11	0.12	0.18
2010-2012	1	2	3	4	5	6	7	8	9	10

Note: This table reports the standard error of the banks' probability of transition to each specific decile as explained in tables 4.10.b and 4.10.b.i.

Table 4.11.a - Explanatory Power (Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	6.355	-9.24
lnp2	5.311	-3.39
lnq1	0.629	145.61
lnq2	0.249	52.79
lnNPI	-0.782	-0.56
lnPE	2.32	77.49
Intercept	-4.356	-189.2
R-squared	0.9679	
Adj R-squared	0.9679	
F value	30920.17	
AIC	-3168.858	
BIC	-3121.786	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2003 - 2004. The model is

$$lnPBT_{it}=a_0+a_1lnp_{1,it}+a_2lnp_{2,it}+a_3lnq_{1,it}+a_4lnq_{2,it}+a_5lnNPI_{it}+a_6PE+\varepsilon_{it}$$

where 'NPI' is the negative profit indicator.

Table 4.11.b - Explanatory Power (With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	6.832	35.02
lnp2	5.217	62.13
lnq1	0.643	185.47
lnq2	0.245	78.95
lnNPI	-0.719	-32.01
lnσ1	-4.19	-15.42
lnσ2	-0.282	-28.17
lnR*iskadj* PE	2.286	174.5
Intercept	-3.762	-140.85
R-squared	0.9688	
Adj R-squared	0.9687	
F value	23769.94	
AIC	-3339.53	
BIC	-3279.02	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2003 - 2004. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.11.c - Explanatory Power (With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	6.74242	34.22
lnp2	5.229748	62.25
lnq1	0.6396195	177.74
lnq2	0.2460867	78.96
lnNPI	-0.7285963	-32.17
lnσ1	-3.550622	-10.47
lnσ2	-0.2228062	-10.52
lnPE	0.4924921	1.15
lnR*iskadj* PE	1.801845	11.69
Intercept	-3.884564	-82.16
R-squared	0.9688	
Adj R-squared	0.9688	
F value	21160.66	
AIC	-3347.453	
BIC	-3280.224	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted index (RiskadjPE) during the period 2003 - 2004. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.12.a - Explanatory Power (Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.412835	20.53
lnp2	4.97556	53.77
lnq1	0.6897809	182.86
lnq2	0.1997642	56.09
lnNPI	-0.9781478	-29.1
lnPE	2.380831	173.75
Intercept	-4.508334	-275.71
R-squared	0.9646	
Adj R-squared	0.9646	
F value	30920.17	
AIC	-1825.649	
BIC	-1778.578	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.12.b - Explanatory Power (With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.786887	22.99
lnp2	4.815141	52.57
lnq1	0.6928146	184.35
lnq2	0.201067	56.85
lnNPI	-0.9753453	-29.41
lnσ1	-7.111705	-20.36
lnσ2	-0.3243116	-30.44
lnR*iskadj* PE	2.350867	173.17
Intercept	-3.760162	-130.05
R-squared	0.9655	
Adj R-squared	0.9655	
F value	21461.74	
AIC	-2010.555	
BIC	-1950.052	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.12.c - Explanatory Power (With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.714126	22.43
lnp2	4.842894	52.77
lnq1	0.69205	184.11
lnq2	0.2008189	56.84
lnNPI	-0.9746925	-29.43
lnσ1	-5.797857	-11.91
lnσ2	-0.2548981	-12.23
lnPE	0.5368337	0.87
lnR*iskadj* PE	1.822932	13.31
Intercept	-3.919492	-77.97
R-squared	0.9656	
Adj R-squared	0.9656	
F value	19122.32	
AIC	-2023.558	
BIC	-1956.332	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.13.a - Explanatory Power (Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.773101	17.57
lnp2	5.33497	62.74
lnq1	0.659424	185.71
lnq2	0.2104386	63.57
lnNPI	-0.9407045	-32.7
lnPE	2.314552	171.42
Intercept	-4.235353	-281.2
R-squared	0.951	
Adj R-squared	0.9509	
F value	29813.09	
AIC	-323.048	
BIC	-259.716	
Observations	9228	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2004 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.13.b - Explanatory Power (With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.992359	19.15
lnp2	5.237133	62.17
lnq1	0.663727	186.79
lnq2	0.214565	65.06
lnNPI	-0.93569	-32.9
lnσ1	-6.10242	-18.69
lnσ2	-0.28927	-28.37
lnR*iskadj* PE	2.266391	171.27
Intercept	-3.59452	-131.17
R-squared	0.9523	
Adj R-squared	0.9522	
F value	22945.77	
AIC	-327.102	
BIC	-262.947	
Observations	9228	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2004 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.13.c - Explanatory Power (With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.978969	19.03
lnp2	5.241282	62.19
lnq1	0.66329	186.09
lnq2	0.214194	64.78
lnNPI	-0.93492	-32.87
lnσ1	-5.71923	-13.95
lnσ2	-0.26481	-14.06
lnPE	0.209187	1.55
lnR*iskadj* PE	2.062555	15.56
Intercept	-3.6478	-82.83
R-squared	0.9688	
Adj R-squared	0.9688	
F value	20399.59	
AIC	-327.492	
BIC	-256.209	
Observations	9228	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted index (RiskadjPE) during the period 2004 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.14.a - Predictive Power (Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.537054	20.53
lnp2	0.93687	53.77
lnq1	1.097112	182.86
lnq2	0.802212	56.09
lnNPI	1.250745	29.1
lnPE	1.026267	173.75
Intercept	-4.50833	-275.71
R-squared	0.9646	
Adj R-squared	0.9646	
F value	27896.39	
AIC	-1825.65	
BIC	-1778.58	
MSE	0.043417	
MAE	0.133035	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2005-2006 and the reggressors are estimated values during the period 2003 - 2004. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.14.b - Predictive Power (With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.554275	22.99
lnp2	0.92295	52.57
lnq1	1.077968	184.35
lnq2	0.82007	56.85
lnNPI	1.355611	29.41
lnσ1	1.697113	20.36
lnσ2	1.151466	30.44
lnR*iskadj* PE	1.028568	173.17
Intercept	-3.76016	-130.05
R-squared	0.9655	
Adj R-squared	0.9655	
F value	21461.74	
AIC	-2010.56	
BIC	-1950.05	
MSE	0.042077	
MAE	0.130262	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2005-2006 and the reggressors are estimated values during the period 2003 - 2004. The profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.14.c - Predictive Power (With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.543625	22.43
lnp2	0.92827	52.77
lnq1	1.076778	184.11
lnq2	0.819058	56.84
lnNPI	1.354704	29.43
lnσ1	1.383581	11.91
lnσ2	0.905014	12.23
lnPE	0.231405	0.87
lnR*iskadj* PE	0.797582	13.31
Intercept	-3.91949	-77.97
R-squared	0.9656	
Adj R-squared	0.9656	
F value	19122.32	
AIC	-2023.56	
BIC	-1956.33	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2005-2006 and the reggressors are estimated values during the period 2003 - 2004. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.15.a - Predictive Power (Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.501226	5.43
lnp2	1.082966	33.93
lnq1	0.783005	81.53
lnq2	1.046238	35.21
lnNPI	0.710211	118.46
lnPE	1.393904	129.83
Intercept	-4.69172	-149.54
R-squared	0.8913	
Adj R-squared	0.8912	
F value	6286.08	
AIC	5504.216	
BIC	5564.722	
MSE	0.143038	
MAE	0.256737	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.15.b - Predictive Power (With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.493095	5.84
lnp2	1.10292	33.1
lnq1	0.811878	83.02
lnq2	0.998054	32.98
lnNPI	0.680999	102.46
lnσ1	0.459795	15.73
lnσ2	0.438879	7.03
lnR*iskadj* PE	1.4107	125.13
Intercept	-4.47963	-79.39
R-squared	0.8932	
Adj R-squared	0.8931	
F value	8568.89	
AIC	5409.356	
BIC	5456.428	
MSE	0.140736	
MAE	0.254154	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005-2006. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.15.c - Predictive Power (With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.494818	5.31
lnp2	1.080946	33.77
lnq1	0.788649	78.22
lnq2	1.036066	34.13
lnNPI	0.701778	101.22
lnσ1	0.11996	2.73
lnσ2	0.013733	0.18
lnPE	-0.238572	-2.08
lnR*iskadj* PE	1.158203	10.28
Intercept	-4.69242	-78.66
R-squared	0.893	
Adj R-squared	0.893	
F value	5694.77	
AIC	5401.231	
BIC	5468.461	
Observations	6152	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005-2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.16.a - Predictive Power (Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-0.13273	-1.69
lnp2	10.13347	66.23
lnq1	2.828794	123.22
lnq2	0.004358	52.42
lnNPI	0.639062	97.12
lnPE	1.193108	153.71
Intercept	-4.5078	-207.82
R-squared	0.9202	
Adj R-squared	0.9201	
F value	17717.55	
AIC	6566.479	
BIC	6616.388	
MSE	0.119098	
MAE	0.233977	
Observations	9228	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2010-2012 and the reggressors are estimated values during the period 2004 - 2006. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.16.b - Predictive Power (With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.269428	1.96
lnp2	1.21732	64.12
lnq1	0.924924	128.8
lnq2	1.009884	49.92
lnNPI	0.59831	85.28
lnσ1	0.598909	32.56
lnσ2	0.993284	20.41
lnR*iskadj* PE	1.176718	146.27
Intercept	-3.84217	-99.41
R-squared	0.9232	
Adj R-squared	0.9231	
F value	13844.45	
AIC	6212.79	
BIC	6276.955	
MSE	0.114611	
MAE	0.227207	
Observations	9228	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2010-2012 and the reggressors are estimated values during the period 2004-2006. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.16.c - Predictive Power (With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.11555	1.48
lnp2	9.719735	64.03
lnq1	2.907151	126.89
lnq2	0.004153	49.99
lnNPI	0.59898	84.31
lnσ1	0.528423	17.22
lnσ2	0.872332	13.55
lnPE	0.160277	2.17
lnR*iskadj* PE	1.019586	18.41
Intercept	-3.92247	-82.21
R-squared	0.9233	
Adj R-squared	0.9232	
F value	12316.75	
AIC	6206.558	
BIC	6277.852	
Observations	9228	

Note: This table presents results for the ordinary least squares (OLS) regressions where the dependent variable is the banks' profits before tax (PBT) in 2010-2012 and the reggressors are estimated values during the period 2004-2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.17.a.i - Explanatory Power (Saved - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.355353	18.16
lnp2	4.141994	59.1
lnq1	0.606738	211.1
lnq2	0.224642	80.38
lnNPI	-0.53211	-42.85
lnPE	2.62758	221.94
Intercept	-4.225	-342.66
R-squared	0.9575	
Adj R-squared	0.9575	
F value	41775.62	
AIC	-1.72329	
BIC	49.50165	
Observations	11135	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2009, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.17.b.i - Explanatory Power (Saved - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.970881	23.17
lnp2	3.958462	57.4
lnq1	0.629261	219.2
lnq2	0.216429	78.1
lnNPI	-0.5796	-47.16
lnσ1	-4.39324	-17.75
lnσ2	-0.31353	-42.15
lnR*iskadj* PE	2.588879	225.25
Intercept	-3.55881	-184.52
R-squared	0.9596	
Adj R-squared	0.9596	
F value	32928.26	
AIC	-591.064	
BIC	-525.241	
Observations	11135	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2009, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.17.c.i - Explanatory Power (Saved - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.962167	22.75
lnp2	3.960305	57.29
lnq1	0.628913	209.1
lnq2	0.216545	77.69
lnNPI	-0.57893	-46.65
lnσ1	-4.32582	-14.31
lnσ2	-0.30844	-20.49
lnPE	0.052312	0.39
lnR*iskadj* PE	2.537377	19.08
Intercept	-3.56962	-105.51
R-squared	0.9596	
Adj R-squared	0.9596	
F value	29267.34	
AIC	-589.215	
BIC	-516.079	
Observations	11135	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2009, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.17.a.ii - Explanatory Power (Failed - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.493156	5.54
lnp2	3.767304	10.62
lnq1	0.627934	50.61
lnq2	0.207265	18.77
lnNPI	-0.49406	-7.84
lnPE	2.729469	52.51
Intercept	-4.32778	-70.28
R-squared	0.9616	
Adj R-squared	0.9609	
F value	1421.8	
AIC	77.26981	
BIC	114.5094	
Observations	467	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2009, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.17.b.ii - Explanatory Power (Failed - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	4.01251	6.1
lnp2	3.602417	9.79
lnq1	0.637722	49.61
lnq2	0.207278	17.68
lnNPI	-0.5122	-7.69
lnσ1	-4.91842	-3.4
lnσ2	-0.24862	-5.81
lnR*iskadj* PE	2.723743	50.35
Intercept	-3.78931	-34.26
R-squared	0.9631	
Adj R-squared	0.9626	
F value	2001.78	
AIC	53.21085	
BIC	82.23516	
Observations	467	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2009, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.17.c.ii - Explanatory Power (Failed - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.485842	5.3
lnp2	3.748749	10.33
lnq1	0.627654	48.86
lnq2	0.206173	17.9
lnNPI	-0.48882	-7.45
lnσ1	-0.53965	-0.31
lnσ2	0.033009	0.42
lnPE	-0.29242	-0.41
lnR*iskadj* PE	3.021451	4.22
Intercept	-4.39226	-24.48
R-squared	0.9631	
Adj R-squared	0.9623	
F value	1312.66	
AIC	61.3918	
BIC	102.7691	
Observations	467	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2009, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.18.a.i - Explanatory Power (Saved - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.428648	18.95
lnp2	4.142195	59.62
lnq1	0.609498	215.55
lnq2	0.22241	80.72
lnNPI	-0.53249	-41.98
lnPE	2.630305	225.66
Intercept	-4.23389	-348.57
R-squared	0.9584	
Adj R-squared	0.9584	
F value	43291.78	
AIC	-54.2518	
BIC	-2.9313	
Observations	11288	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.18.b.i - Explanatory Power (Saved - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.04117	23.92
lnp2	3.966035	57.82
lnq1	0.630279	223.87
lnq2	0.215821	79.2
lnNPI	-0.58083	-46.06
lnσ1	-4.34075	-17.57
lnσ2	-0.31031	-41.93
lnR*iskadj* PE	2.595149	228.66
Intercept	-3.57529	-187.13
R-squared	0.9602	
Adj R-squared	0.9602	
F value	33871.85	
AIC	-572.894	
BIC	-506.948	
Observations	11288	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.18.c.i - Explanatory Power (Saved - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	3.004382	23.26
lnp2	3.973541	57.8
lnq1	0.62886	213.34
lnq2	0.216272	78.96
lnNPI	-0.57797	-45.4
lnσ1	-4.06101	-13.48
lnσ2	-0.28908	-19.24
lnPE	0.218172	1.62
lnR*iskadj* PE	2.380164	17.91
Intercept	-3.62029	-107.53
R-squared	0.9602	
Adj R-squared	0.9602	
F value	30112.98	
AIC	-573.531	
BIC	-500.258	
Observations	11288	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.18.a.ii - Explanatory Power (Failed - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	1.754262	2.05
lnp2	3.805233	8.66
lnq1	0.584914	33.45
lnq2	0.243313	16.72
lnNPI	-0.48614	-9.67
lnPE	2.739301	34.93
Intercept	-4.1999	-47.36
R-squared	0.9398	
Adj R-squared	0.9387	
F value	799.36	
AIC	96.24241	
BIC	122.4882	
Observations	314	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.18.b.ii - Explanatory Power (Failed - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.216009	2.65
lnp2	3.582742	8.4
lnq1	0.614904	32.95
lnq2	0.229773	14.69
lnNPI	-0.50496	-10.41
lnσ1	-7.0352	-4.31
lnσ2	-0.31389	-6.44
lnR*iskadj* PE	2.699339	35.84
Intercept	-3.52974	-26.75
R-squared	0.9462	
Adj R-squared	0.9448	
F value	662.35	
AIC	66.81525	
BIC	100.4444	
Observations	314	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.18.c.ii - Explanatory Power (Failed - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	2.258244	2.7
lnp2	3.563839	8.36
lnq1	0.619995	32.57
lnq2	0.229359	14.68
lnNPI	-0.50797	-10.47
lnσ1	-8.93023	-4.11
lnσ2	-0.3982	-4.94
lnPE	-1.04879	-1.31
lnR*iskadj* PE	3.734585	4.72
Intercept	-3.34907	-17.59
R-squared	0.9466	
Adj R-squared	0.945	
F value	590.37	
AIC	67.03551	
BIC	104.4012	
Observations	314	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.19.a.i - Explanatory Power (Saved - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.514523	1.92
lnp2	3.669998	29.62
lnq1	0.387219	63.77
lnq2	0.143459	25.81
lnNPI	-0.60864	-110.33
lnPE	7.619215	102.23
Intercept	-2.75874	-114.86
R-squared	0.7769	
Adj R-squared	0.7767	
F value	4661.35	
AIC	16072.83	
BIC	16138.35	
Observations	10741	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2008 - 2009. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.19.b.i - Explanatory Power (Saved - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-0.03805	-0.14
lnp2	3.658819	28.61
lnq1	0.385105	61.7
lnq2	0.140309	24.63
lnNPI	-0.58387	-92.76
lnσ1	-2.35406	-13.92
lnσ2	0.058647	3.59
lnR*iskadj* PE	9.54274	98.96
Intercept	-2.78818	-65.94
R-squared	0.7817	
Adj R-squared	0.7816	
F value	6405.97	
AIC	15879.07	
BIC	15930.04	
Observations	10741	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2008 - 2009. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.19.c.i - Explanatory Power (Saved - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	0.331691	1.22
lnp2	3.788914	30.07
lnq1	0.384612	62.62
lnq2	0.143231	25.54
lnNPI	-0.60459	-96.11
lnσ1	-0.4391	-2.25
lnσ2	0.124245	7.55
lnPE	-4.84634	-6.28
lnR*iskadj* PE	11.41914	18.8
Intercept	-3.02446	-69.59
R-squared	0.784	
Adj R-squared	0.7838	
F value	4319.03	
AIC	15726.78	
BIC	15799.58	
Observations	10741	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2008 - 2009. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.19.a.ii - Explanatory Power (Failed - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-0.37169	-0.28
lnp2	3.869407	6.28
lnq1	0.377611	11.26
lnq2	0.10601	3.7
lnNPI	-0.52731	-22.02
lnPE	8.811628	22.19
Intercept	-2.81774	-22.14
R-squared	0.7407	
Adj R-squared	0.7369	
F value	198.5	
AIC	598.0064	
BIC	626.3545	
Observations	424	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the conventional profit efficiency index (PE) during the period 2008 - 2009. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.19.b.ii - Explanatory Power (Failed - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-0.89605	-0.65
lnp2	3.701819	5.75
lnq1	0.372469	10.77
lnq2	0.108527	3.71
lnNPI	-0.49376	-18.42
lnσ1	-2.77828	-4.23
lnσ2	-0.06039	-0.91
lnR*iskadj* PE	10.7474	21.1
Intercept	-2.52823	-13.38
R-squared	0.7407	
Adj R-squared	0.7369	
F value	198.5	
AIC	598.0064	
BIC	626.3545	
Observations	424	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by the risk-adjusted profit efficiency index (RiskadjPE) during the period 2008 - 2009. The model is

$$lnPBTit=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.19.c.ii - Explanatory Power (Failed - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-0.13917	-0.1
lnp2	3.678193	5.81
lnq1	0.389827	11.35
lnq2	0.094801	3.27
lnNPI	-0.49881	-18.89
lnσ1	-1.45722	-1.99
lnσ2	-0.01711	-0.26
lnPE	-1.29947	-0.41
lnR*iskadj* PE	9.786533	3.83
Intercept	-2.74501	-14.13
R-squared	0.7451	
Adj R-squared	0.7396	
F value	134.49	
AIC	596.639	
BIC	637.1363	
Observations	424	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011, where the dependent variable is the banks' profits before tax (PBT) and one of the reggressors is the profit efficiency level estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2008 - 2009. The model is

1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6σ1,it+a7σ2,it+a8PEit+a9RiskadjPEit+εit

where 'NPI' is the negative profit indicator.

Table 4.20.a.i - Predictive Power (Saved - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.03967	-12.81
lnp2	-0.09171	-2.07
lnq1	0.951351	79.03
lnq2	0.901386	29.36
lnNPI	(omitted)	
lnPE	1.999715	60.14
Intercept	-3.46586	-115.35
R-squared	0.8125	
Adj R-squared	0.8124	
F value	5749.8	
AIC	9194.141	
BIC	9234.946	
MSE	0.233395	
MAE	0.339636	
Observations	10562	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2009 where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.20.b.i - Predictive Power (Saved - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-1.57304	-12.63
lnp2	-0.13147	-2.9
lnq1	0.960801	81.94
lnq2	0.877277	27.92
lnNPI	(omitted)	
lnσ1	1.12939	15.24
lnσ2	0.915889	11.85
lnR*iskadj* PE	2.482158	57.66
Intercept	-2.77484	-45.94
R-squared	0.8193	
Adj R-squared	0.8191	
F value	4289.91	
AIC	8910.75	
BIC	8965.149	
MSE	0.223825	
MAE	0.332758	
Observations	10562	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2009 where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.20.c.i - Predictive Power (Saved - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-107.37	-2.12
lnp2	74.52968	4.24
lnq1	40.89226	7.47
lnq2	51.91907	3.58
lnNPI	136.3475	22.18
lnσ1	-132.819	-5.1
lnσ2	35.22742	1.16
lnPE	-382.663	-2.96
lnR*iskadj* PE	731.8866	4.39
Intercept	-217.454	-8.73
R-squared	0.0761	
Adj R-squared	0.0753	
F value	96.44	
AIC	148538.6	
BIC	148611.2	
Observations	10562	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2009 where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.20.a.ii - Predictive Power (Failed - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.69584	-2.96
lnp2	0.354065	0.93
lnq1	0.834847	12.88
lnq2	0.850989	4.6
lnNPI	(omitted)	
lnPE	1.794449	9.03
Intercept	-3.05387	-13.83
R-squared	0.7391	
Adj R-squared	0.7318	
F value	101.42	
AIC	332.3878	
BIC	351.7099	
MSE	0.330863	
MAE	0.440599	
Observations	683	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2009 where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.20.b.ii - Predictive Power (Failed - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.51582	-3.4
lnp2	0.37515	1
lnq1	0.913571	14.82
lnq2	0.737862	4.2
lnNPI	(omitted)	
lnσ1	2.864358	5.38
lnσ2	0.955498	1.61
lnR*iskadj* PE	2.203014	8.93
Intercept	-2.40805	-6.64
R-squared	0.7761	
Adj R-squared	0.7673	
F value	87.66	
AIC	308.0854	
BIC	333.8482	
MSE	0.283927	
MAE	0.392973	
Observations	683	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2009 where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.20.c.ii - Predictive Power (Failed - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.48359	-3.34
lnp2	0.311336	0.8
lnq1	0.921264	14.56
lnq2	0.729611	4.13
lnNPI	(omitted)	
lnσ1	3.000012	5.13
lnσ2	1.147044	1.67
lnPE	-1.47133	-0.57
lnR*iskadj* PE	4.098706	3.22
Intercept	-2.30069	-5.61
R-squared	0.7765	
Adj R-squared	0.7664	
F value	76.44	
AIC	309.7496	
BIC	338.7328	
Observations	683	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2009 where the dependent variable is the banks' profits before tax (PBT) in 2008-2009 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.21.a.i - Predictive Power (Saved - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-3.73535	-14.36
lnp2	-0.06357	-1.7
lnq1	1.079356	91.12
lnq2	0.842444	27.98
lnNPI	-4.08416	-5.84
lnPE	1.881796	56.44
Intercept	-3.63095	-124.28
R-squared	0.838	
Adj R-squared	0.8379	
F value	6082.76	
AIC	10147.42	
BIC	10195.46	
MSE	0.245819	
MAE	0.353785	
Observations	9910	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.21.b.i - Predictive Power (Saved - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.5275	-15.7
lnp2	-0.23463	-7.78
lnq1	1.133825	126.36
lnq2	0.980442	41.21
lnNPI	-3.34648	-6.78
lnσ1	0.795138	18.96
lnσ2	1.365982	20.99
lnR*iskadj* PE	0.926437	88.83
Intercept	-3.45331	-66.64
R-squared	0.9039	
Adj R-squared	0.9037	
F value	8284.43	
AIC	6434.63	
BIC	6496.389	
MSE	0.145311	
MAE	0.264845	
Observations	9910	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.21.c.i - Predictive Power (Saved - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.4614	-15.32
lnp2	-0.24089	-8.01
lnq1	1.138786	127
lnq2	1.008827	41.98
lnNPI	-3.30469	-6.72
lnσ1	0.798796	19.12
lnσ2	1.443693	21.96
lnPE	-0.29645	-7.22
lnR*iskadj* PE	1.014881	63.16
Intercept	-3.44273	-66.65
R-squared	0.9046	
Adj R-squared	0.9044	
F value	7423.08	
AIC	6384.672	
BIC	6453.292	
Observations	9910	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.21.a.ii - Predictive Power (Failed - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-5.03888	-2.62
lnp2	-0.05954	-0.27
lnq1	1.044135	16.13
lnq2	0.788009	6.33
lnNPI	(omitted)	
lnPE	1.770526	9.86
Intercept	-3.3836	-21.07
R-squared	0.8452	
Adj R-squared	0.8414	
F value	221.68	
AIC	263.8854	
BIC	283.9394	
MSE	0.195404	
MAE	0.34776	
Observations	432	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.21.b.ii - Predictive Power (Failed - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.41591	-1.92
lnp2	-0.30346	-1.55
lnq1	1.028379	19.94
lnq2	1.107121	9.9
lnNPI	(omitted)	
lnσ1	0.394217	3.8
lnσ2	1.065526	3.09
lnR*iskadj* PE	0.732894	12.5
Intercept	-3.19686	-10.98
R-squared	0.8966	
Adj R-squared	0.893	
F value	248.89	
AIC	183.6271	
BIC	210.3658	
MSE	0.130572	
MAE	0.275928	
Observations	432	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.21.c.ii - Predictive Power (Failed - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-2.38651	-1.89
lnp2	-0.30273	-1.55
lnq1	1.027393	19.86
lnq2	1.12018	9.71
lnNPI	(omitted)	
lnσ1	0.393271	3.79
lnσ2	1.119171	3.08
lnPE	-0.12053	-2.97
lnR*iskadj* PE	0.768219	8.09
Intercept	-3.17106	-10.68
R-squared	0.8967	
Adj R-squared	0.8925	
F value	216.96	
AIC		
BIC		
Observations	432	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2005 - 2006. The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.22.a.i - Predictive Power (Saved - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	-17.6316	-14.36
lnp2	-0.07175	-1.7
lnq1	1.698951	91.12
lnq2	1.306069	27.98
lnNPI	-3.57316	-5.84
lnPE	0.649634	56.44
Intercept	-3.63095	-124.28
R-squared	0.838	
Adj R-squared	0.8379	
F value	6082.76	
AIC	10147.42	
BIC	10195.46	
MSE	0.245819	
MAE	0.353785	
Observations	9910	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2008 - 2009. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.22.b.i - Predictive Power (Saved - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	202.0122	15.7
lnp2	-0.25433	-7.78
lnq1	1.855665	126.36
lnq2	1.508099	41.21
lnNPI	-3.32905	-6.78
lnσ1	1.466188	18.96
lnσ2	-7.22762	-20.99
lnR*iskadj* PE	0.251945	88.83
Intercept	-3.45331	-66.64
R-squared	0.9039	
Adj R-squared	0.9037	
F value	8284.43	
AIC	6434.63	
BIC	6496.389	
MSE	0.145311	
MAE	0.264845	
Observations	9910	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2008 - 2009. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma1,it+a7\sigma2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.22.c.i - Predictive Power (Saved - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	196.7285	15.32
lnp2	-0.26111	-8.01
lnq1	1.863785	127
lnq2	1.551762	41.98
lnNPI	-3.28749	-6.72
lnσ1	1.472933	19.12
lnσ2	-7.6388	-21.96
lnPE	-0.10234	-7.22
lnR*iskadj* PE	0.275997	63.16
Intercept	-3.44273	-66.65
R-squared	0.9046	
Adj R-squared	0.9044	
F value	7423.08	
AIC	6384.672	
BIC	6453.293	
Observations	9910	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'solvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2008 - 2009. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2008 - 2009. The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Table 4.22.a.ii - Predictive Power (Failed - Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	23.78186	2.62
lnp2	-0.05856	-0.27
lnq1	1.617352	16.13
lnq2	1.80863	6.33
lnNPI	(omitted)	
lnPE	0.55041	9.86
Intercept	-3.3836	-21.07
R-squared	0.8452	
Adj R-squared	0.8414	
F value	221.68	
AIC	263.8854	
BIC	283.9394	
MSE	0.195404	
MAE	0.34776	
Observations	432	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2008 - 2009. The profit efficiency level is estimated by the conventional profit efficiency index (PE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6PE+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.22.b.ii - Predictive Power (Failed - With Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	5.974745	1.92
lnp2	-0.2937	-1.55
lnq1	1.697737	19.94
lnq2	2.343993	9.9
lnNPI	(omitted)	
lnσ1	0.998242	3.8
lnσ2	5.538302	3.09
lnR*iskadj* PE	0.184075	12.5
Intercept	-3.19686	-10.98
R-squared	0.8966	
Adj R-squared	0.893	
F value	248.89	
AIC	183.6271	
BIC	210.3658	
MSE	0.130572	
MAE	0.275928	
Observations	432	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2008 - 2009. The profit efficiency level is estimated by the risk-adjusted profit efficiency index (RiskadjPE). The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator. MSE and MAE stand for Mean Square Error and Mean Absolutely Error respectively.

Table 4.22.c.ii - Predictive Power (Failed - With & Without Risk)

lnPBT	Coefficient	b/St.Er.
lnp1	5.902035	1.89
lnp2	-0.29299	-1.55
lnq1	1.696109	19.86
lnq2	2.371642	9.71
lnNPI	(omitted)	
lnσ1	0.995847	3.79
lnσ2	5.817135	3.08
lnPE	-0.03747	-3.17
lnR*iskadj* PE	0.192947	8.09
Intercept	-3.17106	-10.68
R-squared	0.8967	
Adj R-squared	0.8925	
F value	216.96	
AIC	185.3926	
BIC	215.4736	
Observations	432	

Note: This table presents results for the ordinary least squares (OLS) regressions for the 'insolvent' banks after 2011 where the dependent variable is the banks' profits before tax (PBT) in 2010-2011 and the reggressors are estimated values during the period 2005 - 2006. The profit efficiency level is estimated by both the conventional (PE) and the risk-adjusted profit efficiency index (RiskadjPE) during the period 2008 - 2009. The model is

$$lnPBTit+n=a0+a1lnp1,it+a2lnp2,it+a3lnq1,it+a4lnq2,it+a5lnNPIit+a6\sigma 1,it+a7\sigma 2,it+a8PEit+a9RiskadjPEit+\varepsilon it$$

where 'NPI' is the negative profit indicator.

Chapter 5

Conclusion

This thesis covers four different fields in the financial economics and banking literature using the concept of efficiency as a linking bridge between these topics. As a research output we contribute both from a theoretical and an empirical perspective. We provide a methodology in the spectrum of M&As among banks within a latent class context. Additionally, we propose a theoretical framework that combines economic efficiency with liquidity creation. We also present an econometric framework to compare and evaluate potential M&A activity. Last but not least we suggest a new index that accounts both for profit efficiency and stability.

More precisely, Chapter 2 deals with the fact that surveys of bank efficiency intrinsically draw conclusions based on the assumption that all banks in a sample use the same production technology. Nevertheless, neglecting the existence of unobserved differences in technological regimes might distort the efficiency estimates by assigning incorrectly these deviations as inefficiency. We approach this consideration by estimating the unobserved heterogeneity in the UK and the Greek banking technologies using a latent class stochastic frontier model. In order to increase our confidence regarding the extracted inferences, two distinct empirical methodologies are followed: a pooled cross-section method and a panel data modelling strategy. Finally we examine numerous potential M&As scenarios among banks that belong to different technological regimes, in order to test whether there is a transition of the new bank to a more efficient technological class resulting from the M&A activity. The empirical findings suggest that bank-heterogeneity can be fully captured by two different technological regimes. This holds under both modelling strategies. We also provide empirical evidence of improved economic efficiency in both banking sectors after certain potential consolidation activity. This raises concerns in recent specific cases of Greek M&As that were not found to result in cost efficiency enhancement.

In Chapter 3 we address the issue that the global financial crisis distorted one of the primordial functions of banks' raison d'être: liquidity creation. For this purpose we propose a novel hypothesis the "Cost Efficiency-Liquidity Creation Hypothesis" that argues that "cost efficiency" enhancing banks' M&A can create both increased liquidity and social welfare surplus. To test empirically our suggested hypothesis we propose a novel use of a stress test scenario under a panel vector autoregressive (PVAR) methodology where we account for a macroeconomic, a financial and a bank shock. This permits us to shed light on the direction of causality among cost efficiency and liquidity creation. Additionally, we investigate the level of liquidity of all historical and potential consolidation activity in the UK and Greek banking sector by employing recent measures of liquidity creation. Last, we suggest a framework to evaluate and compare the robustness of bank consolidation activity by using new half-life measures. The empirical evidence we get via our proposed "Cost Efficiency-Liquidity Creation Hypothesis" reveals that specific potential consolidation activity can facilitate the flow of credit in the economy and at the same time create social well-being surplus. This is established via the stress scenario and precisely from the positive impact of cost efficiency on liquidity creation. Additionally, the results highlight that the direction of causality is stronger from liquidity creation to cost efficiency. The UK banking sector with respect to liquidity creation is found to be more robust in all three different shocks. Lastly, as far as the Greek banking sector is concerned, the half-life and total effect results of adverse macroeconomic and bank-specific conditions demonstrate that the Greek banking system was more robust with respect to liquidity creation before its recent systemic formation. This casts further doubts on the decisions made by policy authorities as far as the recent wave of consolidation activity is concerned.

Finally, Chapter 4 stresses the fact that conventional tests of banking efficiency do not take into account the trade-off that might exist between banks' efficiency and stability. Specifically, it is argued that current measures of efficiency do not take into consideration whether banks' managers are taking too much or too little risk relative to the value maximising amount and consequently do not account on whether this increases bank's degree of instability. For this purpose we suggest a new profit efficiency index which accounts for two different types of risks: credit risk and the risk deriving from excessive leverage. In this way, on one hand we compare the deviation of banking efficiency estimates of our proposed risk-adjusted index and the standard one in various states of the economy. On the other hand we investigate the explanatory and forecasting power of these two measures accounting for an additional differentiation in our sample; solvent banks and insolvent banks, both during and in the aftermath of the crisis. The results suggest that the risk-adjusted index exhibits considerably less deviation of its estimated profit efficiency values among all different time horizons compared to the conventional index. Furthermore, we provide strong empirical evidence of the superiority that characterises our suggested index in terms of both its explanatory and predictive power in contrast to the current profit efficiency measure. This holds in all periods that both indicators are tested and in three samples: all banks, solvent and insolvent. Additional robustness tests confirm our extracted inferences. Noteworthy is the fact that when both measures coexist in the same model the dynamic effects have as a result the conventional index to become ineffective and to create contradictory inferences with respect to fundamental assumptions that underlie the theory of profit efficiency.

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